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Report on

1956 RESEARCH SURVEYS

BY

THE RESEARCH AND DEVELOPMENT STAFF

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1. Introduction

In accordance with previous practice, this report was prepared to consolidate material relating to the 1956 research surveys. These reports provide a record of the principal activities during the year, together with a summary of the important findings. Much material that is still subject to further investigation appears in some of the tables. Such data are included in the report to preserve them in a readily accessible form.

The pattern of surveys conducted during the year conforms closely to that established in 1954 and 1955. As usual, field activities were under the direction of the Special Statistics Branch with the Research and Development Staff being primarily responsible for the technical aspects of the work and the analysis of the data. As in past years, a number of other professional workers in the Division participated in all phases of the work. Section 3.5 of Chapter 3 and all of Chapter 10 were prepared by the staff of the Special Statistics Branch.

The acreage and livestock survey conducted in June 1956 was extended to Kentucky, Virginia, and the following North Central States: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, Ohio, South Dakota, and Wisconsin. The survey thus covered a total of 23 States. A total of about 1,100 sample segments was allocated to these States in the same manner as in earlier surveys in the Southern States, except that a crop reporting district stratification was applied within States in place of the type of farming stratification used previously. The segments were selected in a 2-stage design within crop reporting districts in each State with counties serving as primary sampling units. Because the 1956 survey was conducted by the closed-segment method, which was expected to reduce the variability between segments within counties considerably, the number of segments per county was reduced to 2 from the previous level of 7 with a correspondingly larger number of counties being included in the sample. The method of drawing the sample was such that the probabilities of selection for the counties were proportional to the numbers of farms in those counties as shown by the Census.

The survey was conducted primarily by the closed-segment approach, except that livestock data were also reported for entire farms for all places having a resident operator living within the segment. The dual approach on livestock was employed because there was some uncertainty about the practicability of recording livestock information by the closed-segment method. All places with an operator within each sample segment were contacted and pertinent information on amounts of land operated and acreages of principal crops was recorded for the entire place along with the livestock information. These data were recorded in addition to the closed-segment data for all places having a resident operator within the segment solely for the purpose of deciding which of those places should be counted as farms in arriving at a count of farm operators. The classification of places as "farm" and "non-farm" was made by statisticians in the office after the survey was completed. In 1956 the questionnaires were edited in the State offices, but all of the editing was later reviewed in the Washington office before the data were tabulated.

An acreage verification survey was conducted by supervisors in August, about two months after interviewers completed the June enumeration. One-sixth of the sample segments and 1/3 of the agricultural tracts within those segments were selected for verification. This represented a departure from verification studies made in previous years on samples of fields for which specified crops were reported in June. This change was made in the belief that errors in reporting crop acreages might be compensating because farmers might report correct crop acreages, even though they erred in locating the appropriate fields on the photographs. Obviously, the operator tracts selected for verification in 1956 in many cases did not cover entire farms, but the tracts were sufficiently large so that compensating effects could be taken into account. The 1956 verification work consisted of comparing the crop or land use for each field in the tract as reported in June and as found in August, checking field boundaries drawn on the aerial photos in June for accuracy, comparing reported acreages with planimetered acreages, and making detailed measurements on fields of specified crops to determine both "gross" and "net" acreages.

Surveys were again conducted as of October 1 and December 1 for data on harvested crop acreages, reported crop production, and livestock inventories. But in 1956 these surveys were conducted entirely by interview. Individual agricultural tracts of land lying entirely within the boundaries of the sample segments under the control of a single operator were used as sampling units. One-eighth of the tracts enumerated in June were contacted as of October 1 and 1/4 as of December 1. On the average about 1 operator tract per segment was contacted in the October survey and about 2 operator tracts per segment in the December survey. These surveys were conducted entirely by the closed-segment approach as in the June survey, except that prospective sales and purchases of livestock were recorded for entire farms when farm operators resided within the boundaries of the sample tracts.

The monthly plant observations on cotton and corn from August 1 to harvest were continued in the Southern States, using a sample of about 1,000 cotton fields and 650 corn fields. Because the June interview survey was conducted by the closed-segment approach, it was possible to select fields for the objective yield studies from among those identified on the aerial photographs in June. The studies on corn were extended to about the same number of corn fields in the North Central States. In the North Central States observations relating to the quality of the crop were made concurrently with observations needed to forecast and estimate yields. The quality observations consisted of current observations on the stage of maturity of the crop, which were used to forecast the dates on which various portions of the crop would be mature and safe from frost. Sample ears were also sent to a central laboratory at Iowa State College each month during the growing season for observations on extent of damage from disease and other sources.

In addition to the studies on corn, objective yield studies were started on soybeans by making monthly observations throughout the growing season on about 150 soybean fields in the principal producing areas of the North Central States.

Studies on winter wheat in Texas and Oklahoma were continued in the spring of 1956 on a sample of about 150 fields.

2. Summary of Results

Results from the June interview survey indicated that the closed-segment approach fulfilled expectations with respect to reduction in sampling errors and general improvement in the quality of reported data. Interviewers liked the procedure because it avoided the complicated rules previously required for identifying farms and determining which farms should be associated with the selected sample segments. The problem of verifying reported data was simplified tremendously because visual inspection of the tracts delineated on the aerial photographs provided a good check on the reasonableness of reported data. Livestock estimates obtained with this approach were somewhat larger than those obtained from data reported for entire farms. It is possible that some interviewers may have recorded more livestock than those actually present within the boundaries of designated tracts at the time of the interview but, everything considered, it seems that data reported for entire farms had a greater likelihood of being subject to errors than the closed-segment data. The differences between estimates from the two approaches were not significant in the North Central States, but they were significant in the South.

Experience in enumeration also indicated that when the sample segments were distributed over as many counties as were used in the June survey, the advantage of using a 2-stage sample design from the standpoint of cost is not very great. If the segments had been allocated to strata within States without the clustering effect of drawing 2 segments per county, the distribution of the segments would have been more efficient statistically and the increased cost of enumeration would have been rather small. In other words, the 2-stage design loses its efficiency rapidly as the total number of counties in the sample is increased.

Estimates of numbers of farms based upon the number of farm operators identified with the boundaries of the sample segments appear to have been quite accurate as judged by the sampling error and other available data. Some difficulties were encountered in differentiating between sharecroppers and rural residents other than croppers from the information recorded for such individuals on the questionnaire by the enumerators. With some minor modifications in the questionnaire that would permit such distinctions to be made in more clear-cut fashion, the approach used in this survey seems to be a satisfactory method of estimating numbers of farms.

The acreage verification work indicated that there are appreciable differences between data recorded for individual farm operator's tracts in the June survey and corresponding data found on the second visit. The most common errors seem to be in the assignment of the reported crops to the fields delineated on the photographs. In many cases such differences were caused by the crop not yet having been planted at the time of the first visit, so that the original data represented intentions. Some departures from intentions occurred after the time of the first interview.

The October 1 and December 1 surveys, that were conducted entirely by interview with the closed-segment approach, indicated that this approach is preferable to mail surveys with interviews on samples of nonrespondents. In fact, a mail approach would be impractical from the standpoint of getting comparable data in these surveys when only portions of farms are enumerated in June, as sometimes happens with the closed-segment approach. Because much of the field work connected with interviewing farmers in these surveys could be combined with travel in the objective yield work, the additional cost of conducting these surveys entirely by interview was not excessive.

The objective yield studies on cotton and corn were set up on a time schedule so that the experimental yield forecasts were available each month during the growing season by official forecast dates. Because the number of sample cotton fields in the South was quite large in relation to the number of sample area segments in which those fields were selected, the clustering of fields was somewhat larger than desirable in many areas. However, the increased size of the sample of fields made it possible to study the behavior of growing plants under various conditions in more detail than had been possible previously.

In the North Central States the studies on the quality of the corn crop indicated that accurate predictions could be made as early as August 1 on the relative portions of the crop that could be expected to reach maturity and be safe from frost by specified dates. Those predictions were compared with the fraction of the crop that actually had reached maturity by specified dates later in the year. Data were also obtained on the extent of damage to grain from various sources when the crop reached maturity. All laboratory tests and examination of sample ears from fields in the North Central States were made at a central laboratory at Iowa State College. Because of an overloading of facilities at the laboratory, these tests were often delayed excessively so that results were not available as promptly as would be required in an operating program. That situation has now been corrected by expanding the laboratory facilities and making necessary arrangements so that these tests can be conducted promptly and the results made available more rapidly.

The studies on soybeans were helped tremendously by some intensive fruit counts made on a small sample of fields by personnel of the State Statistician's office in Illinois. These data were used to construct a forecasting model for forecasting the number of pods to be found on sample plants at specified forecast dates. This model was applied to the extensive data collected at monthly intervals throughout the entire region. Results show that the total numbers of pods found to be present on the sample plants throughout the entire region on specified dates agree closely with the number forecast from observations made one or more months previously.

The studies on winter wheat in Texas and Oklahoma provided data from which yield forecasting formulas are being constructed.

3. June Enumerative Survey

3.1 Sample Design

In 1956 this survey covered a sample of 1,100 area segments allocated to the following States:

Southern	North Central
Alabama	Illinois
Arkansas	Indiana
Georgia	Iowa
Kentucky	Kansas
Louisiana	Michigan
Mississippi	Minnesota
North Carolina	Missouri
Oklahoma	Nebraska
South Carolina	Ohio
Tennessee	South Dakota
Texas	Wisconsin
Virginia	

Because the enumeration was to be made by the closed-segment approach which was expected to reduce the within-county variability between segments considerably, the number of segments per county was reduced to two, with a corresponding increase in the number of counties covered in comparison with those used in previous years. A stratification by crop reporting districts was applied to individual States instead of the type of farming stratification that was used in 1954 and 1955. Within crop reporting districts, counties were selected with probabilities proportional to the Census numbers of farms with two segments being selected at random from each selected county. As in previous years, the non-open country portions of the universe were sampled at the same rate as the open country.

The enumeration was conducted by the closed-segment approach in which crop acreages, other land uses, and livestock numbers were recorded for individual "fields" that could be identified and delineated on large-scale aerial photographs. A detailed accounting was made for all land-use items and livestock numbers found within the boundaries of the selected sample segments. In the enumeration all of the land within the boundaries of these selected sample segments under the control of a single operator was first delineated and recorded on the questionnaire as an "operator tract". After this was done for each such tract, a detailed breakdown was made by individual fields within the tract. All crops and other land-use items were recorded and all livestock present within the boundaries of a tract were listed. All households within the boundaries of each sample segment were contacted for information on the total amount of land operated, acreages of principal crops on the entire place, and total livestock numbers. This information was used to classify places as "farm" and "non-farm" when the data were tabulated. The livestock date were recorded in considerable detail for all places having resident operators within the sample segments so that comparisons could be made between livestock estimates computed from the closed-segment data and corresponding estimates computed from data covering entire farms.

The dual approach on livestock was used because there was some uncertainty about the practicability of basing livestock estimates upon data from the closed-segment approach. Because livestock are free to move about, it appeared that it might be difficult to obtain an accurate count of livestock present on a particular tract of land at the time of the interview.

3.2 Appraisal of the Survey

The results from the closed-segment approach for both land-use and livestock items were gratifying from the viewpoint of simplicity of operation, the reduction in sampling errors, and the apparent accuracy with which data were recorded for individual tracts. Although further studies are needed from the viewpoint of possible reporting errors and other non-sampling errors, there is good reason to believe that, in the States covered by this survey, the closed-segment approach can be adapted to livestock estimates just as well as to crop acreage estimates or to estimates on other land-use items. The size of the computed sampling errors and the remarkably close agreement of the acreage estimates with current Board indications testify to the superiority of the closed-segment approach for crop acreage estimates over the use of the farm as the unit of observation. The sampling errors would have been larger if the farm had been used as the unit of observation.

Non-sampling errors are difficult to assess, particularly for livestock estimates. The presence of some non-sampling errors in the livestock data is clearly indicated by the fact that the closed-segment estimates are uniformly higher than the open-segment estimates. The differences are not large for the North Central States, but they are appreciable for the Southern States. The consistency of the differences from item to item is strong evidence that something other than sampling error is responsible. There may have been some over-reporting of livestock numbers in the closed-segment approach because of the inclusion of some livestock that was not actually within the segment boundaries at the time of the enumeration. But it seems more likely that livestock data reported for entire farms are too low.

In general, data for individual tracts in the closed-segment approach were recorded much more meticulously by the enumerators than data for entire farms. Some interviewers are known to have misunderstood the instructions and, instead of recording data for an entire farm, recorded only livestock numbers that had not already been covered on the closed-segment portion of the farm that fell within the segment boundaries. When that was definitely known to be the case, necessary corrections were made in the editing. But some incomplete reports may have escaped detection. Inspection of the completed questionnaires, together with comments of interviewers and supervisors, gives the impression that the data for entire farms are more subject to error than the closed-segment data.

The most difficulty in applying the closed-segment approach to livestock occurred in open-range areas. It was sometimes difficult to find out whether or not there were any cattle in a particular tract or if there were, who owned them and how many. In some cases, a sample segment included only part of a range and it was impractical to determine the numbers actually present within the segment boundaries. In such cases, interviewers estimated the fraction of the total range that was included in the segment and pro-rated the total number of animals on the entire range to the segment on a percentage basis. This seems to be a satisfactory way of dealing with that problem when it arises, although it would be preferable to have segment boundaries defined in such a way that pro-rating would be unnecessary.

Data on such items as the expected size of calf crop and expected sow farrowings are reported intentions. Non-sampling errors can be expected to be greater in such data than on inventories and births that have occurred. In actual practice, relationships will need to be established between reported intentions and actual performance in the same way that such data are currently analyzed by the Crop Reporting Board. For example, experience in 1955 indicated that only about 75 percent of the sows that were expected to farrow between June 1 and December 1 actually farrowed.

There are also some non-sampling errors in the reported data on crop acreages. Many of these were revealed in the acreage verification part of this study. In some cases, farmers reported incorrect crop acreages or were mistaken in identifying particular fields on the photographs where those crops were grown. Some crops were not yet planted at the time of the survey, and there were doubtless some later departures from intentions.

For cotton there is always a possibility that some acreages reported are acreages in cultivation at the time of the survey rather than the total acreages planted and to be planted. This would not affect the 1956 estimates significantly, except in Texas where abandonment prior to the enumeration was quite heavy.

In the case of wheat, it is suspected that acreages in entire wheat fields were reported as acreage for harvest without deductions being made for portions of fields that were not harvested because of drought.

It is also necessary to remember that the closed-segment data account for all crops and livestock located within the segment boundaries. Only data for experiment stations were omitted. Some crops and livestock were on land which formed parts of places too small to qualify as farms by official definitions and would presumably be left out in an Agricultural Census. In this survey, no attempt was made to deduct non-farm crop acreages from the estimates. Such deductions would consist mainly of small acreages of corn, hay, and pasture. These should not be large enough to have much effect. Livestock numbers on places too small to qualify as farms were negligible in the North Central States. Some non-farm cattle and hogs and a fairly large number of non-farm chickens were picked up in the closed segment enumeration in the South. The closed segment estimates of

livestock were adjusted by deducting the estimated numbers on non-farm places, from information that was recorded for all places on an open-segment basis.

Estimates of farm numbers were of particular interest in appraising the quality of coverage in the survey. The estimate for the South was about 4 percent below the 1954 Census count. The estimate for the North Central States was almost identical with the 1954 Census count. Places were classified as farms according to the point system described in the Report on the 1954 Research Surveys. In the 1956 estimates all tenants, including sharecroppers, were counted as operators.

In general, the operation of the survey proceeded smoothly in all areas. Crop acreage data were tabulated in time for consideration in the preparation of the July acreage report. This survey was not scheduled to produce estimates in time for the June pig crop report, but estimates on cattle, including the calf crop, were available to the Board prior to the release of the calf crop report on July 30. Detailed analyses of costs and other operational matters are not covered in this chapter. As a matter of general interest, it was discovered that about 13 hours of interview time were required per segment in the South, of which 8 hours were spent within the segment and 5 hours were spent in travel to and between segments. In the North Central States the total interviewing time per segment was 11 hours, of which 7 represents time actually spent within the segment. There was considerable variation from State to State, depending upon such factors as dispersion of the sample, nature of the terrain, and differences between supervisors and enumerators. Segments involving small numbers of large fields naturally could be completed in much less time than segments involving large numbers of operators and large numbers of small irregularly shaped fields.

3.3 Estimates of Crop Acreages and Numbers of Farms

These estimates are given in table 3.1 for the 12 Southern States and in table 3.2 for the 11 North Central States. Crop Reporting Board estimates as of July 1 are included for comparison wherever such estimates are available. Sampling errors of the estimates from the June survey are included for selected items. For winter wheat there is reason to believe that acreages reported in the June survey were acreages actually standing as of that date without any deductions for acreages that might not be harvested for various reasons. Estimates of numbers of farms agreed closely with the 1954 Census counts. Logically, one would expect a decrease in total number of farms between the 1954 Census and June 1956. The sampling error in survey estimates is about 3 percent in each of the two regions.

3.4 Livestock, Dairy, and Poultry Estimates

These estimates are given in table 3.3 for the Southern States and table 3.4 for the North Central States. As livestock numbers recorded by both the open-segment approach and the closed-segment approach included livestock for many places that were to small to be counted as farms, an adjustment was made for non-farm livestock. For the open-segment data it was possible to sort out livestock reported on non-farm places. This could not be done for the closed-segment data, but it was assumed that the relative proportions of farm and non-farm livestock would be

the same in the closed-segment data as in the open-segment data. Estimates of non-farm livestock that were deducted in arriving at the estimates shown in tables 3.3 and 3.4 are given in table 3.5.

Table 3.1--Acreage estimates for principal crops and estimate of number of farms--12 Southern States

Item	Crop Reporting Board, July 1, 1956	Research survey	
		Estimate	Sampling error
	1,000 acres	1,000 acres	Percent
Corn:			
Planted	17,606	18,991	5.2
For harvest	17,287	--	
For grain	1/ 15,867	17,214	
Winter Wheat:			
Planted	11,089	--	
For Harvest	7,754	9,634	6.8
Oats:			
Planted	9,546	8,431	7.1
For harvest	4,873	4,097	
Sorghums:			
Planted	12,381	13,471	10.9
For grain	--	9,597	
Cotton:			
Planted	2/ 15,539	14,494	7.2
In cultivation, July 1	15,206		
Soybeans:			
Planted alone	4,357	4,235	10.7
For beans	3,756	3,790	
Interplanted	574	875	
Tobacco planted:	1,223.6	1,326.1	8.0
Burley	289.2	275.8	
Flue Cured	861.6	973.0	
Air Cured	23.5	22.0	
Fire Cured	48.0	55.3	
Peanuts:			
Planted	1,743	1,134	17.3
Number of Farms	3/ 2,151,321	2,066,488	3.3

1/ Based on percent harvested for grain in preceding years, by States.
2/ Unpublished
3/ 1954 Census

Table 3.2--Acreage estimates for principal crops and estimate of number of farms -- 11 North Central States

Item	Crop Reporting Board July 1, 1956	Research survey	
		Estimate	Sampling error
	1,000 acres	1,000 acres	Percent
Corn:			
Planted	55,097	58,662	5.3
For harvest	54,127	--	
For grain	1/ 49,262	56,219	
Winter Wheat:			
Planted	22,438	--	
For harvest	20,019	22,864	6.4
Spring wheat planted	3,079	2,749	
Oats:			
Planted	29,043	28,584	5.0
For grain	25,967	27,785	
Barley:			
Planted	3,622	3,536	12.3
For grain	3,062	3,447	
Soybeans:			
Planted	16,933	16,773	8.9
For beans	16,607	16,580	
Sorghums:			
Planted	7,548	9,600	7.3
For grain	--	7,352	
Number of Farms	2/ 1,641,780	1,647,017	3.0

1/ Based on percent harvested for grain in preceding years, by States.

2/ 1954 Census

Table 3.3--Livestock Estimates for 12 Southern States

Item	Board 1/	Research survey	
		Open segment 2/	Closed segment
	1,000 head	1,000 head	1,000 head
All Cattle on farms June 1, 1956	31,405	32,594	36,520
Cows 2+ on farms June 1, 1956	17,116	17,730	20,175
Heifers and heifer calves under 2 on farms June 1, 1956	--	7,425	8,733
Bulls, steers and male calves on farms June 1, 1956	--	7,439	7,612
Calves:			
Born Jan. 1, 1956 - June 1, 1956	8,664	8,425	10,361
Expected June 1, 1956 - Jan. 1, 1957	4,773	5,624	6,658
Milk Cows:			
On farms June 1, 1956	5,083	5,793	6,417
Milked yesterday	3,287	4,140	4,627
Milk produced per cow in herd (lb.)	3/ 12.5	15.2	15.1
All Hogs on farms June 1, 1956	12,387	11,297	12,495
Hogs 6 mo. + on farms June 1, 1956	--	3,478	3,837
Hogs under 6 mo. on farms June 1, 1956	--	7,819	8,656
Farrowings:			
Sows farrowed Dec. 1, 1955 - June 1, 1956	1,362	1,221	1,362
Pigs saved Dec. 1, 1955 - June 1, 1956	9,070	7,594	8,476
Pigs per litter (number) Dec. 1, 1955- June 1, 1956	6.7	6.2	6.2
Sows to farrow June 1, 1956 - Dec. 1, 1956	1,117	1,277	1,403
All Sheep on farms June 1, 1956	--	7,938	8,323
Breeding ewes on farms June 1, 1956	--	4,365	4,904
Poultry:			
Hens & pullets of laying age on farms 6/1/56	63,371	70,546	71,023
Commercial broilers on farms June 1, 1956	--	297,833	314,890
All other young chicks on farms June 1, 1956	--	70,316	71,785

1/ June 1 estimates by Livestock and Poultry Branch, and Dairy Branch.

2/ Residence of farm operator located within segment.

3/ Daily average for month of June.

Table 3.4--Livestock Estimates for 11 North Central States

Item	Board 1/	Research survey	
		Open segment 2/	Closed segment
	1,000 head	1,000 head	1,000 head
All Cattle on farms June 1, 1956	43,615	43,707	44,411
Cows 2+ on farms June 1, 1956	19,103	20,368	20,622
Heifers and heifer calves under 2 on farms June 1, 1956	--	12,768	12,674
Bulls, steers and male calves on farms June 1, 1956	--	10,571	11,116
Calves:			
Born Jan. 1, 1956 - June 1, 1956	10,194	10,860	10,811
Expected June 1, 1956 - Jan. 1, 1957	6,934	8,139	8,186
Milk Cows:			
On farm June 1, 1956	9,728	10,070	10,185
Milked yesterday	7,993	8,332	8,576
Milk produced per cow in herd (lb.)	3/ 21.9	24.7	24.5
All Hogs on farms June 1, 1956	49,246	47,443	48,660
Hogs 6 mo. + on farms June 1, 1956	--	8,349	8,429
Hogs under 6 mo. on farms June 1, 1956	--	39,094	40,231
Farrowings:			
Sows farrowed Dec. 1, 1955 - June 1, 1956	5,802	5,657	5,775
Pigs saved Dec. 1, 1955 - June 1, 1956	40,821	38,733	39,734
Pigs per litter (number) Dec. 1, 1955-June 1, 1956	7.0	6.8	6.9
Sows to farrow June 1, 1956 - Dec. 1, 1956	3,715	4,244	4,321
All Sheep on farms June 1, 1956	--	10,354	10,154
Breeding ewes on farms June 1, 1956	--	5,250	5,339
Poultry:			
Hens and pullets of laying age on farms June 1, 1956	128,984	131,982	132,974
Commercial broilers on farms June 1, 1956	--	11,367	10,213
All other young chicks on farms June 1, 1956	--	176,753	176,847

1/ June 1 estimates by Livestock and Poultry Branch, and Dairy Branch.

2/ Residence of farm operator located within segment.

3/ Daily average for month of June.

Table 3.5--Estimates of Non-Farm Livestock and Poultry

Item	12 Southern States	11 North Central States
	1,000 head	1,000 head
All cattle June 1, 1956	33	--
Cows 2+ June 1, 1956	16	--
Heifers and heifer calves under 2 June 1, 1956	10	--
Bulls, steers and male calves June 1, 1956	7	--
Milk cows June 1, 1956	5	--
All hogs June 1, 1956	53	4
Hogs 6 months + June 1, 1956	19	2
Hogs under 6 months June 1, 1956	34	2
All sheep June 1, 1956	--	12
Breeding ewes June 1, 1956	--	5
Poultry:		
Hens and pullets, laying age June 1, 1956	2,226	399
All other young chicks June 1, 1956	1,779	350

Sampling errors for a few selected items in the South and in the North Central States are given in table 3.6.

Table 3.6--Sampling Errors of Selected Livestock Items

Item	Southern States		North Central States	
	Open segment	Closed segment	Open segment	Closed segment
	Percent	Percent	Percent	Percent
All cattle	6.4	5.4	6.9	5.4
All hogs	6.6	6.9	5.7	5.8
All sheep	9.1	14.4	11.7	10.1
Hens & pullets, laying age	7.6	7.1	5.3	5.1

As about 500 sample segments were enumerated in each of the two regions, it is possible to predict how large the sampling errors would be in an operating program with a larger sample. The sampling error is inversely proportional to the square root of the sample size. Thus, for example, multiplying the sample size by 4 would cut that error in half. It should also be remembered that in an operating program many of the same sample segments would be enumerated in two successive years so that estimates could be computed from the year to year change. In general, sampling errors from estimates derived in that fashion should be only about half as large as those obtained by direct expansion from a sample of the same size. Inspection of the sampling errors suggests that the use of the closed-segment approach does not reduce sampling errors appreciably for livestock other than cattle. The most significant improvements seem to have occurred for cattle in both regions.

3.5 Acreage Verification Study

In any enumerative survey it is necessary to evaluate the quality of work done by the interviewers. During the early stages of the survey a review will detect substandard work and permit further instruction or replacement of poorer enumerators. Such a review may consist of having the work repeated by a supervisor or another enumerator and comparing the results, or it may be limited to reviewing completed schedules for omissions, inconsistencies and other errors detectable by an editor. A partial re-enumeration may be used to estimate correction factors to be applied to previously-enumerated totals. The primary purpose of the acreage verification on the June 1956 Enumerative Survey was to establish the relationship between reported crop acreages and the net acreages of such crops standing for harvest. Four specified crops were studied more intensely. These were corn, cotton, soybeans, and sorghum. Objective yield studies were being made on all of these except sorghum.

In all the research surveys a spot review was made by supervisors during the early part of the enumeration. In 1954 no further quality check was made. In 1955 supervisors revisited and verified reported acreages in a subsample of fields listed by enumerators. This gave useful comparisons between reported June acreages and the acreages of the specified crops actually standing in the sample fields. But it did not give correction factors to be applied to the total enumerated acreages of these crops because it did not provide for checking or substitutions of the specified crop in other than designated fields. In 1956 the verification work was done on entire operator tracts (defined as that portion of the land area within a segment under the control of one operator) rather than on individual fields for which the specified crops were reported by the first enumerator.

The verification work was done on 1/18 of the operator tracts enumerated in the June survey, the sample consisting of 1/6 of the segments and 1/3 of the tracts on these segments. The sample of segments was chosen in Washington, but

State offices were given a rule for selecting the tracts to be verified in those segments. New aerial photographs (with a scale of 1 inch to 660 feet) were supplied for the selected segments.

Supervisory enumerators revisited the selected tracts about August 1. The field or field subdivision boundaries were carefully drawn on the new photographs, and present land use identified. A field subdivision was an area within a field as outlined in the June survey devoted to one crop or land use, whose width was more than 66 feet. If the present land use differed from that recorded in June, the supervisory enumerator determined whether the designated crop had not been planted, if it had already been harvested, or if it had been planted but abandoned. In addition, for corn, cotton, soybeans, and sorghum, the supervisory enumerator prepared a sketch of the field, showing the shape and dimensions of all areas in which the designated crop was not standing. These areas (less than 66 feet wide) include turn spaces, field borders, gulleys, grassed waterways, "islands", "peninsulas", and narrow strips of other crops or idle land.

A worksheet was used to record the amount of land falling within each classification at the time of the verification. Totals were computed for each classification and a detailed analysis made of the differences between the land use reported in June and that observed in early August.

Some of the more significant results of the study are indicated in table 3.7. Planting of soybeans in the South and sorghums in both the South and the North Central region was still under way at the time of the June survey. Therefore, the June report represented some intended plantings, of which about 20 to 30 percent failed to materialize. Results for corn and soybeans in the North Central States and for cotton and corn in the South give a more representative indication of the relationships between reported planted acreages and the actual gross planted acreages, gross standing acreages, and net standing acreages.

As an aid in understanding the table, the entries in each column will be explained using corn in the North Central States as an example. The number of verified fields classified as corn fields on the June survey--217--is in Column (1). Column (2) shows the acreage reported planted to corn in these fields on the June survey--3311.8 acres. Column (3) lists the verified gross planted acreage--3429.3 acres. This figure is measured acreage on the aerial photographs for fields (or subdivisions) reported in corn in June and found to be corn fields in August, plus measured acreage for fields reported in corn in June and found in August to have been planted but abandoned, plus measured acreage for fields reported planted to other crops in June but found to be corn fields in August. Excluded are fields reported planted to corn in June but found in August never to have been planted to corn. Column (4) shows the gross standing acreage--3258.1 acres. This is the same as Column (3) except

that it excludes field measured acreage planted to corn but abandoned. Column (5) shows the net standing acreage--3102.8 acres. This is the same as Column (4) except that it excludes unplanted scraps and borders in corn fields determined from the field sketches.

This example may be analyzed, taking as 100 percent the acreage which the farmer reported planted or to be planted to corn in June. The verified measured gross acreage of these fields was 36.0 acres (1.1 percent) larger than the reported planted acreage. An additional 81.5 acres (2.4 percent) was in corn fields which had not been reported as planted to corn in June. Thus the verified gross acreage of fields planted to corn was 3429.3 acres--3.5 percent larger than the farmers' reported planted acreage, Column (6) thus reads 103.5 percent.

A total of 171.2 acres (or 5.1 percent of the base) was found to have been planted to corn but abandoned before early August. Most of this acreage was idle, but a small part had been planted to a crop other than corn. The verified gross standing acres thus were 3258.1 acres--1.6 percent less than the farmers' reported planted acreages; 103.5 percent less 5.1 percent equals 98.4 percent. This is the entry in Column (7).

A total of 155.3 acres (or 4.7 percent of the base) was in unplanted borders and scraps of corn fields. Thus the verified net standing acreage was 3102.8 acres--6.3 percent less than the farmers' reported planted acreage. Ninety-eight point four percent less 4.7 percent equals 93.7 percent, the entry in Column (9).

Column (8) is the ratio of the gross acreage standing in August to the gross acreage planted. The difference between 100 percent and the entry in this Column for each crop represents the abandonment to early August.

Column (10) is the ratio of the net acreage standing in August to the gross acreage planted. The difference between Columns (8) and (10) represents the unplanted borders and scraps.

Columns (5), (9), and (10) are not available for the non-specified land uses since, as previously stated, borders and scraps were not measured for these crops or land uses.

Table 3.7--Comparison of June Reported Acres with Verified Acres

Region-- Crop or use	Number of fields classified	Planted acres 1/ June reported acres	Planted acres 1/ Verified gross acres 2/	Verified gross standing acres 2/	Verified net standing acres 2/	Gross planted to June reported (3) ÷ (2)	Gross standing To June reported (4) ÷ (2)	Gross standing To Gross planted (4) ÷ (3)	Net standing To June reported (5) ÷ (2)	Net standing To Gross planted (5) ÷ (3)
	(1)	(2)	(3)	(4)	(5)	Percent (6)	Percent (7)	Percent (8)	Percent (9)	Percent (10)
South										
Cotton	124	1,332.4	1,364.0	1,318.4	1,255.8	102.4	98.9	96.7	94.3	92.1
Corn	202	1,357.0	1,364.0	1,275.5	1,198.0	100.5	94.0	93.5	88.3	87.8
Sorghums	43	997.0	827.1	766.6	753.8	83.0	76.9	92.3	75.6	91.1
Soybeans	21	261.0	193.4	191.4	175.1	74.1	73.3	99.0	67.1	90.5
Oats	61	785.5	811.0	759.3	--	103.2	96.7	93.6	--	--
Winter wheat	39	882.0	889.5	889.5	--	100.9	100.9	100.0	--	--
Barley	16	155.3	170.9	135.7	--	110.0	87.4	79.4	--	--
Tobacco	79	112.9	131.9	131.9	--	116.8	116.8	100.0	--	--
All hay	104	876.0	969.9	948.0	--	110.7	108.2	97.7	--	--
Pasture	193	7,843.0	8,458.0	8,444.9	--	107.8	107.7	99.8	--	--
Other crops	61	152.8	179.2	174.6	--	117.3	114.3	97.4	--	--
Non crops	--	4,410.9	4,876.1	4,876.1	--	110.5	110.5	100.0	--	--
North Central										
Corn	217	3,311.8	3,429.3	3,258.1	3,102.8	103.5	98.4	95.0	93.7	90.5
Sorghums	22	656.0	461.8	445.0	427.0	70.4	67.8	96.4	65.1	92.5
Soybeans	77	1,227.6	1,311.9	1,311.8	1,262.8	106.9	106.9	100.0	102.9	96.3
Oats	113	1,609.5	1,708.3	1,687.8	--	106.1	104.9	98.8	--	--
Winter wheat	74	1,101.5	1,438.4	1,438.4	--	130.6	130.6	100.0	--	--
Barley	13	116.7	110.3	110.3	--	94.5	94.5	100.0	--	--
Spring wheat	6	47.0	45.0	45.0	--	95.7	95.7	100.0	--	--
All hay	150	1,813.5	1,802.3	1,779.5	--	99.4	98.1	98.7	--	--
Pasture	167	5,383.0	5,601.8	5,601.8	--	104.1	104.1	100.0	--	--
Other crops	45	423.3	481.0	452.4	--	113.6	106.9	94.1	--	--
Non crops	--	1,724.2	2,102.6	2,102.6	--	121.9	121.9	100.0	--	--

1/ Except winter wheat, oats, barley and hay which were reported as acres for harvest.

2/ Including acres classified incorrectly as another crop in June. Interplanted acres are included as entire amount.

4. October 1 and December 1 Crop Production and Livestock Surveys

4.1 Purpose

The October 1 survey was conducted to study the possibility of improving estimates of harvested crop acreages and yields of spring sown crops by interviewing a subsample of the tract operators enumerated in June. Information was also obtained on livestock and poultry inventories and on breeding intentions. The livestock items were included to test this method of gathering livestock data at more frequent intervals than are currently employed by the Division in its regular program. The December 1 survey was conducted on another subsample of tract operators enumerated in June for the purpose of preparing estimates of January 1 livestock and poultry inventories and to obtain data on acreages seeded to fall planted grains. Information was also obtained on harvested acreages and final yields of late harvested crops.

These surveys had been conducted by mail, supplemented with some interviewing, in 1954 and 1955. In 1956 they were conducted entirely by interview with the closed-segment approach. Some data on livestock that cannot be obtained properly by the closed-segment approach were recorded for entire farms for farm operators living within the selected sample tracts. The 1956 survey was conducted entirely by interview because results in 1954 and 1955 indicated that this approach would be preferable to the combination mail and interview technique. Mail returns obtained the previous two years required considerable editing and response rates were also so low that the interviews carried most of the weight in the estimates. Furthermore, the shift to the closed-segment approach in 1956 made a mail approach somewhat impractical because the sample tracts selected often covered only parts of farms. Because much of the interviewing connected with these surveys could be done at the same time that interviewers were in the field on the objective yield studies, it was possible to have interviews for these surveys made at the same time with a consequent saving in travel costs.

4.2 Sample Design

The sampling units used in these surveys consisted of individual operator tracts falling entirely within the boundaries of the sample segments enumerated in June. For the October survey, the sample consisted of 1/8 of all such tracts which reported some crops or livestock in June. No data were obtained on agricultural operations outside the segment boundaries. As there are about 8 operator tracts per segment, the October sample consisted of approximately 1 operator tract per segment, or about 1,000 tracts.

In the December survey the sample consisted of 1/4 of all operator tracts which reported some crops or livestock in June. This sample of about 2,000 tracts was twice as large as the one used in October and was also a freshly drawn sample to avoid burdening the same respondents in the two surveys. Because some livestock data needed to be recorded for entire farms, it was necessary to draw a separate sample of 1/4 of all farm operators living within each sample segment but having no farming operations within the boundaries. Such farmers had no possibility of being picked up in the sample of operator tracts. These operators were mainly "croppers" whose crops were included in the report for a landlord's tract in June, but whose livestock and poultry were reported separately. Data recorded for entire farms consisted mainly of actual and intended sales and purchases that were needed to project December 1 estimates of livestock inventories to a January 1 date.

4.3 Crop Acreage and Production Estimates

Acreage estimates were computed from ratios of data reported in October and December to data reported for the same tracts in June. As acreages reported as planted in the later surveys sometimes differed from planted acreages reported in June, it was possible to compute new estimates of planted acreages also. Some of these differences in reported planted acreages may have been caused by memory bias, but to a large extent these later reports can be regarded as a quality check on data reported in June. At the time of the June survey some reported planted acreages were intentions and actual plantings may have departed from those intentions. In some cases, errors were made in naming the crop growing on a specified field or in recording the acreage of a crop in that field. Such errors were brought to light on the later surveys. October/June and December/June ratios of planted and harvested crop acreages are shown for selected crops for the South and for the North Central States in table 4.1. Obviously, some harvested acreages reported in June were acreages intended for harvest. Data reported on later surveys sometimes included intentions, but represented mostly acreages already harvested. Acreage estimates for the two regions derived by applying these ratios to estimates previously computed in June are shown for the two regions in table 4.2. The corresponding December Crop Reporting Board estimates are given for comparison. Average reported yields per harvested acre for selected crops are compared with corresponding December Board estimates in table 4.3.

Table 4.1--October and December ratios of planted and harvested acres to June planted acres

Crop	October/June ratio	December/June ratio
	Percent	Percent
A. Southern States		
Corn, planted	94.1	98.7
Harvested for grain	83.4	87.4
Cotton, planted	97.0	100.1
Harvested	92.3	94.5
Sorghum, planted	77.1	93.2
Harvested for grain	42.7	43.8
Soybeans, alone, planted	91.5	86.9
Harvested for beans	75.2	69.2
Tobacco, harvested	103.0	101.5
Peanuts, alone, planted	98.6	99.7
Harvested for nuts	59.4	96.0
B. North Central States		
Corn, planted	100.7	98.7
Harvested for grain	91.6	87.6
Spring wheat, planted	97.7	117.9
Harvested for grain	57.3	72.3
Barley, planted	93.2	100.4
Harvested for grain	72.5	87.7
Oats, planted	91.3	96.5
Harvested for grain	81.5	86.1
Sorghum, planted	96.2	95.7
Harvested for grain	32.5	41.0
Soybeans, alone, planted	104.4	98.0
Harvested for beans	102.6	95.6

Table 4.2--Research estimates of planted and harvested acres compared with Board

Crop	Research		Board
	October	December	December
	1,000 acres	1,000 acres	1,000 acres
A. Southern States			
Corn, planted	17,871	18,744	17,640
Harvested for grain	15,838	16,598	15,716
Cotton, planted	14,059	14,508	15,135
Harvested	13,378	13,697	13,955
Sorghum, planted	10,386	12,555	11,728
Harvested for grain	5,752	5,900	5,666
Soybeans, planted	3,875	3,680	4,483
Harvested for beans	3,185	2,931	3,942
Tobacco, harvested	1,366	1,346	1,218
Peanuts, alone, planted	1,118	1,131	1,720
Harvested for nuts	674	1,089	1,335
B. North Central States			
Corn, planted	59,073	57,899	54,614
Harvested for grain	53,734	51,388	46,358
Spring Wheat, planted	2,686	3,241	3,086
Harvested for grain	1,575	1,987	2,140
Barley, planted	3,296	3,550	3,760
Harvested for grain	2,564	3,113	3,111
Oats, planted	26,097	27,584	29,586
Harvested for grain	23,296	24,611	24,393
Sorghum, planted	9,235	9,187	7,474
Harvested for grain	3,120	3,936	2,878
Soybeans, planted	17,511	16,438	16,953
Harvested for beans	17,209	16,035	16,352

Table 4.3--Research estimates of yield per harvested acre compared with December Board

Crop and unit	Research		Board
	October	December	December
A. Southern States			
Corn ..... Bushels	29.7	32.2	29.9
Cotton..... Pounds	354	317	354
Sorghums..... Bushels	39.3	24.9	24.2
Soybeans..... Bushels	20.4	18.6	17.7
Tobacco..... Pounds	1,520	1,666	1,599
Peanuts..... Pounds	1,027	1,286	1,124
B. North Central States			
Corn..... Bushels	56.4	57.1	52.8
Spring Wheat..... Bushels	11.8	19.7	14.0
Barley..... Bushels	17.6	27.8	24.5
Oats..... Bushels	37.7	37.4	34.7
Sorghums..... Bushels	11.8	18.9	16.5
Soybeans..... Bushels	26.6	23.4	22.9

In appraising the reported data, it was quite evident that intended plantings in June did not always materialize. This was especially true for sorghum. In some cases, soybeans were erroneously reported in place of sorghum in June. It also appears that in the October and December surveys, some farmers forgot acreages that were abandoned soon after planting. Acreages reported as planted in these later surveys sometimes tended to be the acreages still standing at the time of the survey without allowance being made for abandonment earlier in the season. Cotton appears to be a good example of this situation. The estimate of cotton planted from the June survey data was 14,494,000 acres as compared with the unpublished Board estimate of 15,539,000 that was made at the same time. But in December, estimates of acreage harvested from the research survey agreed closely with Board estimates although reported abandonment is considerably less than the difference between planted and harvested acreage estimates computed from the June and December data.

The estimate of winter wheat seeded for all purposes in the fall of 1956 in the North Central States was 17,971,000 acres as compared with the December Board estimate of 17,976,000 acres. In the South the estimate of winter wheat seeded for all purposes was 12,312,000 acres compared with the Board estimate of 9,391,000 acres. For the North Central States, the estimate from the research survey was based on the December/June ratio of wheat reported as planted in the fall of 1956 to plantings for the fall of 1955 in identical tracts. For the Southern States, the estimate was based on the ratio of acreage reported as planted in the fall of 1956 to the acreage reported as harvested the previous June.

4.4 Livestock and Poultry Estimates

Estimates of livestock and poultry inventories as of October 1 and December 1 are given in tables 4.4 and 4.5. Estimates of livestock numbers were computed by two different methods. Method 1 consisted of computing percentage changes from June for specie totals. After the total for each specie was estimated, the numbers in various subclasses under each specie were estimated from the currently reported percentage breakdown. In Method 2, percent change indications were computed from June data for each subclass separately, and the total for the specie was derived by adding the separate subclass estimates. Results obtained by both methods are shown in the tables. The estimate of number of calves expected to be born between December 1, 1956 and January 1, 1957 seems to be unreasonably high for both the South and the North Central States. Consequently, monthly averages of 844,000 in the South and 1,387,000 for the North Central States were used to adjust December inventories to January 1 inventories.

Table 4.4--October 1, 1956 Closed Segment Livestock Estimates

Item	Southern States			North Central States		
	Ratio to June	Number by--Method 1	Number by--Method 2	Ratio to June	Number by--Method 1	Number by--Method 2
	Percent	1,000 head	1,000 head	Percent	1,000 head	1,000 head
Cattle, All	91.5	33,416	33,433	95.6	42,457	42,620
Cows, 2 yrs. +	--	18,218	18,460	--	19,092	20,704
Cows, under 2 yrs.	--	8,283	7,947	--	13,462	12,801
Bulls & male calves	--	6,915	7,026	--	9,903	9,115
Milk cows in herd	--	6,309	6,083	--	6,990	10,440
Cows milked yesterday	--	4,644	4,493	--	4,545	6,758
Milk produced per cow in herd (Pounds)	--	12.5	--	--	14.7	--
Hogs, All	104.7	13,082	13,674	94.6	46,032	46,019
6 months +	--	7,875	7,863	--	25,133	25,119
Under 6 months	--	5,207	5,811	--	20,899	20,900
Sows farrowed 6/1-12/1	--	1,325	1,456	--	3,502	3,461
Pigs per litter(Number)	--	6.9	--	--	6.9	--
Sheep, All	67.5	5,618	5,696	231.8	23,537	23,921
Breeding ewes 1+	--	3,449	3,080	--	6,143	5,980
Chickens, All farm	83.2	118,816	119,865	74.3	230,197	223,669
Hens & pullets of laying age	--	86,914	88,495	--	182,746	174,329
Other farm chickens	--	31,902	31,370	--	47,451	49,340
Eggs laid per 100 hens (Number)	--	37.3	--	--	38.2	--

Table 4.5--December 1, 1956 Closed Segment Livestock Estimates

Item	Southern States			North Central States		
	Ratio to June	Number by--Method 1	Number by--Method 2	Ratio to June	Number by--Method 1	Number by--Method 2
	Percent	1,000 head	1,000 head	Percent	1,000 head	1,000 head
Cattle, All	88.4	32,284	32,434	102.6	45,566	45,164
Cows, 2 yrs. +	--	18,936	19,186	--	22,685	23,200
Cows under 2 yrs.	--	7,172	7,668	--	12,513	12,915
Bulls & Male calves	--	6,176	5,580	--	10,368	10,049
Milk cows in herd	--	4,996	5,955	--	11,357	11,214
Cows milked yesterday	--	3,002	3,678	--	7,748	7,710
Milk produced per cow in herd (Pounds)	--	11.2	--	--	16.1	--
Calves born 6/1-12/1	--	5,063	--	--	8,321	--
December calves 12/1-1/1	--	1,675		--	1,889	
December purchases	--	766	--	--	1,165	--
December sales	--	1,499	--	--	3,953	--
December farm slaughter	--	128	--	--	389	--
Hogs, All	106.1	13,257	--	84.9	41,312	--
6 months +	--	6,138	--	--	17,351	--
Under 6 months	--	7,119	--	--	23,961	--
Sows farrowed 6/1-12/1	--	984	1,042	--	3,410	3,509
Pigs saved per litter(no.)	--	6.6	--	--	6.7	--
Spring farrowings 12/1-6/1	--	1,258	--	--	5,267	--
December farrowings	--	134	--	--	116	--
December purchases	--	558	--	--	820	--
December sales	--	1,671	--	--	9,060	--
December farm slaughter	--	1,895	--	--	806	--
Sheep, All	79.2	6,592	6,960	116.7	11,850	11,900
Breeding ewes 1+	--	4,504	5,213	--	5,071	4,974
December lambs	--	484	--	--	381	--
December purchases	--	0	--	--	802	--
December sales	--	10	--	--	1,379	--
December farm slaughter	--	4	--	--	3	--
Sheep shorn in 1956	--	8,063	--	--	9,523	--
Wool per sheep shorn	--	7.48 lbs.	--	--	6.66 lbs.	--
Chickens, All farm	67.5	96,395	98,199	60.1	186,202	193,526
Hens & pullets of laying age	--	81,851	84,020	--	162,593	170,739
Pullets not laying	--	8,088)	14,179	--	17,473)	22,787
Other farm chickens	--	6,456)		--	6,136)	
Eggs laid per 100 hens (no.)	--	29.4	--	--	43.13	--
Tracts with chickens as percent of 1955	96.4	--	--	99.6	--	--

These estimates were computed from October/June and December/June ratios for data from identical tracts. In the December survey farm operators living inside the sample segments were asked about livestock and poultry inventories on entire farms. They were also asked about their intentions to buy, sell, and slaughter cattle, hogs, and sheep during the month of December. These reported intentions were combined with data on expected births reported in the closed-segment data to estimate the net change in inventories from December 1956 to January 1957. These computed January 1 inventories are compared with January 1, 1957 Board estimates in table 4.6.

Table 4.6--January 1, 1957 Livestock Inventory Estimates

Item	Research Survey		Board
	Open segment	Closed segment	
	1,000 head	1,000 head	1,000 head
A. Southern States			
Cattle, All	29,772	33,098	26,838
Hogs, All	9,768	10,383	11,043
Sheep, All	7,695	7,062	6,697
Chickens, All	1/ 107,251	1/ 96,395	91,148
Hens and pullets laying age	1/ 91,160	1/ 81,851	1/ 70,703
B. North Central States			
Cattle, All	42,641	44,278	40,905
Hogs, All	30,559	32,383	37,517
Sheep, All	16,801	11,651	9,290
Chickens, All	1/ 197,183	1/ 186,202	171,453
Hens and pullets of laying age	1/ 160,970	1/ 162,593	1/157,790

1/ December Estimates

The research estimates of cattle on farms January 1 in both the South and the North Central region are higher than corresponding Board estimates. However, the closed-segment estimate for the South is not as much higher than the Board estimate in December as it was in June. Research indications of January 1 hog numbers are substantially lower than Board estimates. The change from December 1 to January 1 reflects the heavy sales forecast for the month of December in the North Central States and the heavy sales and farm slaughter forecast for the South.

The research estimates of the calf crop for 1956 are higher than Board estimates, except for the October estimate in the North Central States. These comparisons are given in table 4.7. The June 1955 estimate of the 1955 calf crop in the Southern States was also higher than the Board estimate for the area. It is possible that at the time of the June survey, farmers over-estimated the calves to be born during the remainder of the year. At least this appears to be the situation in June with respect to sows to farrow in the next 6 months. The December 1 survey asked for the number of calves born since the June survey, and also for the number expected to be born during December. There may have been some double reporting of calves born from January 1 to June 1 and from June 1 to December 1. Apparently, farmers over-estimated the number of calves to be born in December, because the rate of calving reported as expected for that month is much higher than calving reported for the previous 6 months. The June-December rate of calving was used in December to make the estimates in table 4.7.

Table 4.7--Research estimates of 1956 calf crops compared with Board

Item	Calf crop, 1956	
	Southern States	North Central States
Research estimates		
June 1, 1956	17,019	18,997
October 1, 1956	17,345	16,766
January 1, 1957	16,979	20,517
Board		
January 1, 1957	13,300	16,918

In arriving at a forecast of the number of calves to be born during December, it may be more accurate to ask for the number actually born during previous months and to apply that rate, rather than asking farmers to estimate the number expected during December.

Comparisons of the monthly distribution of litters of pigs are shown in table 4.8.

Table 4.8--Research estimates of monthly distribution of litters in 1956 compared with Board

Month	Research estimates		Board
	October 1	December 1	December 1
	Percent	Percent	Percent
A. Southern States			
June	13.6	12.2	11.8
July	14.1	16.5	14.7
August	14.6	14.8	22.0
September	17.5	23.0	23.9
October	18.4	23.0	16.5
November	21.8	10.5	11.1
B. North Central States			
June	12.4	17.2	13.2
July	14.4	17.0	13.4
August	18.1	16.4	25.3
September	26.3	32.2	28.4
October	13.2	13.9	13.9
November	15.6	3.3	5.8

The October 1 survey indicated that in the Southern States, 103.8 percent as many sows were expected to farrow between June 1 and December 1 as was forecast for that same period the previous June. The December survey indicates that only 74.3 percent of the sows expected to farrow actually farrowed during the June-November period. The situation in December is similar to that recorded in earlier surveys in the Southern States. In the North Central States the farmers overestimated June-November farrowings by at least 20 percent in June. Although estimates of total farrowings during June-November were about the same for the North Central States in both the October 1 and December 1 surveys, the monthly distribution of litters was quite different in the December survey than in the October survey.

4.5 Costs

Because the October 1 and December 1 surveys could be combined with objective yield work that was in progress on the same dates, the cost of conducting these surveys entirely by interview was quite small as anticipated. Some preliminary analyses of the cost situation suggest that about two tracts per segment constitute an optimum allocation for interview surveys of this type.

5. Objective Cotton Yield Surveys

5.1 Procedures and Sample Design

These surveys, which were also conducted in 1954 and 1955, were continued during the 1956 growing season in the 10 Southern States. A sample of about 1,000 fields was selected with some regard to the total cotton acreage in each State, but a minimum of 70 fields was allotted to each State so that the sample would be sufficiently large by States to detect differences between States with respect to plant behavior. Within each State, fields were selected with probabilities proportional to size from information recorded in the June interview survey. Because the June survey was conducted by the closed-segment method, all cotton fields in the June survey were delineated on aerial photographs. This greatly simplified the identification of selected sample cotton fields. As in previous years, the first visit to the sample field was made as of August 1, at which time the grower was interviewed before observations were made in the sample field. Second and third visits were made to the sample fields as of September 1 and October 1 for plant observations. A post-harvest survey was made after harvest time to interview the farmer and to obtain gleaning data on the sample field. This survey was not tied to any specific date, but was made in each portion of a State after most of the fields were expected to be harvested. In 1956 a special rate of fruiting survey was made in the sample fields one week after the regular August 1 objective survey. This survey was made to measure the amount of fruit set during the week for comparison with fruiting rates that are computed from August 1 maturity classifications.

As in previous years, two sample plots, each consisting of a double 10-foot row section, were selected for observation in each field. The location of the first plot was determined by a pair of numbers representing the number of rows to be counted along the edge of the field and the number of steps or paces to be taken into the field. The second plot was located by proceeding 30 rows and 30 paces farther into the field. The sampling numbers, provided field workers for locating the first plot, were selected by statisticians in the Washington office and were chosen in such a way that corners and edges of the fields were represented in their proper proportion in comparison with sample plots located in interior portions of the field. When there was no definite pattern of rows in a field, or when it was impossible to count rows, an equal number of paces was substituted for a row count to determine the proper plot location. The number of fields selected in each State and the number on which observations were made on each visit are shown in table 5.1.

Table 5.1--Number of cotton fields selected by States

State	Number selected	Number in which counts were made				
		August 1 regular	August 1 rate of fruiting	September 1	October 1	Post-harvest
Ala.	70	69	11	69	69	65
Ark.	125	123	22	122	122	74
Ga.	70	68	14	67	61	41
La.	70	65	12	62	62	26
Miss.	125	122	22	118	114	79
N. C.	70	62	12	63	63	47
Okla.	70	68	13	68	68	61
S. C.	70	69	13	69	69	55
Tenn.	70	69	13	68	67	66
Texas	264	249	45	208	141	95
Total	1004	964	177	914	836	609

5.2 August 1 Survey

The operator of the farm on which the sample field was located was interviewed at this time before any observations were made in the sample fields. This interview provided information on the operator's cotton acreage, descriptive information about the selected sample field, and the grower's appraisal of prospective yield. Pertinent results from this interview are given in table 5.2 for the sample fields.

Table 5.2--August 1 farm interview data for sample field

State	Acres planted per field		Net acres in cultivation August 1	Forecast yield per acre
	June 1 survey	August 1 survey		
	Acres	Acres	Acres	Bales
Ala.	11.4	10.8	10.7	0.84
Ark.	29.3	29.3	29.2	1.09
Ga.	14.5	14.5	14.2	0.75
La.	44.0	43.1	34.8	1.08
Miss.	21.4	21.2	20.8	1.05
N. C.	4.6	4.7	4.2	0.90
Okla.	21.6	21.0	20.6	0.52
S. C.	9.6	9.6	9.5	0.84
Tenn.	8.5	8.1	8.0	1.12
Texas	70.4	69.0	62.4	0.50
10 States	43.1	42.3	38.9	0.74

The first three columns of the preceding table show the acres of cotton planted in the sample field as reported in the June interview survey, the acres reported as actually planted at the time of the August 1 survey, and the net acres remaining in cultivation as of August 1. The last column of the table shows the grower's estimate of prospective yield in terms of bales per acre.

After the interview was completed, sample plots were selected in the sample field and the following observations made in each sample plot:

1. Width across 4 row spaces.
2. Number of hills or plants.
3. Number of large bolls.
4. Number of open bolls.
5. Weight of seed cotton in open bolls.

More detailed counts were made on two hills beyond each of the two plots. On two hills beyond the first plot separate counts were made of:

1. Number of burrs and open bolls.
2. Number of large unopen bolls.
3. Number of small bolls.
4. Number of blooms.
5. Number of squares.

On the two hills beyond the second plot the same observations were made, but in addition the number of fruit in each category that showed evidence of damage was recorded. The numbers of damaged locks in burrs, open bolls, and large unopen bolls were also recorded. The detailed counts of fruit by categories on the two hills beyond each sample plot were used to estimate the total number in each category for the entire sample plot. These estimated counts per 10 feet of row are shown in table 5.3.

Table 5.3--August 1 fruit counts

State	Average row spacing	Fruit per 10-foot rows				Percent of full load	Total fruit load
		Large bolls	Small bolls and blooms	Squares	Total fruit		
	Feet	Number	Number	Number	Number	Percent	Number
Ala.	3.192	16	47	114	177	92.0	192
Ark.	3.181	23	56	142	221	93.3	237
Ga.	3.207	44	30	92	166	94.5	176
La.	3.535	43	46	88	177	98.8	179
Miss.	3.212	33	57	146	236	94.5	250
N. C.	3.477	29	53	141	223	89.5	249
Okla.	3.308	0.5	4	54	58.5	55.1	106
S. C.	3.229	34	33	71	138	92.7	149
Tenn.	3.191	8	36	164	208	84.8	245
Texas	3.267	16	14	51	81	82.8	98
Region	3.266	21	29	86	136	86.2	158

The percent of full load shown in the table was derived by classifying sample fields according to the kind of fruit observed on the plants. Plants already showing large bolls were assumed to have a full load. Plants showing blooms or small bolls but no large bolls were assumed to have 75 percent of a full load. Plants not yet showing any blooms or small bolls were assumed to have 25 percent of a full load. The total fruit load shown in the last column of the table was computed by dividing the total fruit counted in all categories by the average percent of full load computed from this maturity classification. The percent of fields in each of the three maturity classes is shown in table 5.4, along with the computed average percent of full load.

Columns (5), (6), and (7) in the table show the computation of the weekly fruiting rate as estimated from the August 1 fruit counts and maturity classifications. Because plants showing squares only and those showing small bolls and blooms are assumed to be fruiting at the same rate, the percentages of fields in these two categories were combined in Column (5). Plants in the large boll category were assumed to have a fruiting rate of zero. Column (7) in the table gives the estimated weekly fruiting rate in terms of numbers of fruit resulting from this calculation. These figures are expressed as percentages of the maximum fruit load in column (6). The method of computing the weekly fruiting rate has been described in published reports.

Table 5.4--August 1 distribution of fields by maturity categories and computation of bolls expected per 10 feet of row

State	Percent of fields by maturity classes			Percent of full load	Fruiting rate			Bolls to come	Bolls set	Total bolls expected
	Large bolls	Small bolls and blooms	Squares		Percent (2) + (3)	Relative weekly rate	Fruit per week			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Ala.	73.9	23.2	2.9	92.0	26.1	4.35	8.35	24.8	63.0	87.8
Ark.	82.9	12.2	4.9	93.3	17.1	2.85	6.75	20.0	79.0	99.0
Ga.	80.9	17.6	1.5	94.5	19.1	3.18	5.60	16.7	74.0	90.7
La.	95.4	4.6	0.0	98.8	4.6	.77	1.36	3.9	89.0	92.9
Miss.	77.9	22.1	0.0	94.5	22.1	3.68	9.20	27.3	90.0	117.3
N. C.	77.4	12.9	9.7	89.5	22.6	3.77	9.39	27.8	82.0	109.8
Okla.	2.9	55.9	41.2	55.1	97.1	16.18	17.15	51.0	4.3	55.3
S. C.	73.9	24.6	1.5	92.7	26.1	4.35	6.48	19.0	67.0	86.0
Tenn.	44.9	52.2	2.9	84.8	55.1	9.18	22.49	66.9	44.0	110.9
Texas	51.0	39.0	10.0	82.8	49.0	8.17	10.10	30.3	30.0	60.3
Region	60.9	31.0	8.1	86.2	39.1	6.52	10.3	30.5	50.4	80.9

Experience in previous years has indicated that the number of bolls still to be formed between August 1 and September 1 is about three times the computed weekly fruiting rate. In 1956 these relationships pointed to the additional bolls recorded in Column (8). Combining that figure with the total number of bolls already set as of August 1 gives the total number of bolls expected as shown in Column (10). Although the sample was not sufficiently large to produce reliable estimates for individual States, the computations were made by individual States as a matter of interest. To arrive at an August 1 yield forecast, the total number of bolls expected, shown in the last column of table 5.4, must be multiplied by some estimate of the average amount of cotton per boll.

On August 1, 1956 it was assumed that the weight of seed cotton per boll would be equal to the average weight found in 1954 and 1955. This seemed like a reasonable assumption because boll size appeared to be associated with the size of the 100 percent fruit load in 1954 and 1955. In 1956 the August 1 indication of fruiting potential appeared to be about midway between the potential found in 1954 and 1955. The computation of a yield forecast in terms of pounds of lint per acre is shown in table 5.5.

Table 5.5--August 1 yield forecast

State	Total bolls expected per 10 ft. row	Average boll weight	Weight of seed cotton per 10 ft. row	Conversion Factor: Grams seed cotton to pounds of lint per acre	Gross yield of lint per acre	Net yield
	Number	Grams	Grams		Pounds	Pounds
Ala.	87.8	5.46	479	1.113	533	480
Ark.	99.0	4.71	466	1.117	521	469
Ga.	90.7	5.24	475	1.108	526	473
La.	92.9	5.00	464	1.006	467	420
Miss.	117.3	5.07	595	1.106	658	592
N. C.	109.8	4.55	500	1.022	511	460
Okla.	55.3	5.67	314	1.074	337	303
S. C.	86.0	5.06	435	1.101	479	431
Tenn.	110.9	4.91	545	1.113	607	546
Texas	60.3	4.23	255	1.089	277	249
Region	80.9	4.82	390	1.088	424	382

The first column in this table shows the total number of bolls expected to be produced per 10 feet of row. The second column is the average weight of seed cotton per boll found in 1954 and 1955. The third column is the computed grams of seed cotton expected to be produced per 10 feet of row. The fourth column is the conversion factor for converting the weight of seed cotton per 10 feet of row to an estimate of pounds of lint per acre. Applying that factor to Column 3 gives the total yield in terms of pounds of lint per acre without any allowance for normal harvesting losses or for possible losses of cotton from other causes between

September 1 and harvest time. Assuming a 10 percent loss, the August 1 yield forecast should be 90 percent of the gross yield. This is the net yield shown in the last column of the table.

The "probability of survival" model studied in 1954 and 1955 was also used to derive an estimate of the number of bolls expected to reach maturity. In this computation fields were classified into the following 4 maturity classes on August 1:

1. Large bolls present.
2. Small bolls present, but no large bolls.
3. Blooms present, but no bolls.
4. Only squares present.

The percent of fields falling in each category was computed and used to weight the hypothetical "probability of survival" for each kind of fruit on plants in each of these maturity classes. The "probability of survival" for each class of fruit in each of these 4 maturity classes is shown in table 5.6.

Table 5.6--Probability of survival for categories of fruit counted August 1, by stage of maturity of plant

Kind of fruit	Probability by stage of maturity				Weighted probability
	(1)	(2)	(3)	(4)	
Large bolls	1.000	--	--	--	1.000
Small bolls	.761	.779	--	--	.767
Blooms	.500	.512	.957	--	.504
Squares	.239	.244	.457	.500	.262

For example, only about 23.9 percent of the squares on plants in maturity stage 1 as of August 1 were expected to produce mature bolls, whereas 50 percent of the squares on plants in maturity stage 4 on August 1 were expected to survive. The last column of the table shows the average probability of survival for all types of fruit, taking into account the average stage of maturity attained by the plants as of August 1. Applying these probabilities of survival to the August 1 fruit counts leads to the estimated yields shown in table 5.7.

Table 5.7--August 1 yield forecast from "Probability of Survival" computation

State	Bolls expected to produce cotton	Seed cotton per boll	Seed cotton per 10 ft. of row	Conversion factor to pounds lint per acre	Gross yield of lint per acre	Net yield of lint per acre
	Number	Grams	Grams		Pounds	Pounds
Ala.	77.8	5.46	425	1.113	473	454
Ark.	98.2	4.71	463	1.117	517	496
Ga.	87.9	5.24	461	1.108	511	490
La.	93.6	5.00	468	1.080	505	485
Miss.	107.5	5.07	545	1.106	603	579
N. C.	106.7	4.55	485	1.022	496	476
Okla.	36.4	5.67	206	1.074	221	212
S. C.	78.3	5.06	396	1.101	436	419
Tenn.	88.7	4.91	436	1.113	485	466
Texas	45.7	4.23	193	1.087	210	202
Region	69.7	4.82	336	1.088	366	351

All of the steps in the computation are also shown in the table. The net yield in terms of pounds of lint per acre shown in the last column was derived from the preceding column by deducting an estimated 4 percent harvesting loss. This deduction was smaller than that used in table 5.5 because the "probability of survival" model already made deductions for fruit failing to reach maturity.

5.3 August Rate of Fruiting Survey

One week after the August 1 objective counts were made, 20 percent of the fields were revisited and counts repeated to measure the increase in fruit set during the week. This increase was compared with the increase forecast from the August 1 counts and August 1 maturity classifications. The results are shown in table 5.8.

Table 5.8--Comparisons of rate of fruiting from August 1 regular and special surveys

State	August 1 regular survey				August 1 special survey	
	Total fruit counted	Fruit set per week	Total fruit week later	Expected increase	Increase in fruit in one week	Increase in total bolls in one week
	Number (1)	Number (2)	Number (3)	Percent (4)	Percent (5)	Percent (6)
Ala.	177	8.35	185.4	4.7	10.4	12.2
Ark.	221	6.75	227.8	3.1	4.0	46.1
Ga.	166	5.60	171.6	3.4	- 15.0	0
La.	177	1.36	178.4	0.8	- 26.5	0
Miss.	236	9.20	245.2	3.9	19.4	100.5
N. C.	223	9.39	232.4	4.2	25.4	26.9
Okla.	58.5	17.15	75.6	29.2	47.7	144.0
S. C.	138	6.48	144.5	4.7	- 4.2	17.1
Tenn.	208	22.49	230.5	10.8	14.8	122.5
Texas	81	8.01	89.0	9.9	7.1	20.9
Region	136	10.3	146.3	7.6	8.3	39.4

The first 4 columns of this table show the total fruit counted August 1, the estimated number of fruit expected to be set per week, the total amount of fruit expected to be present a week later, and the expected percentage increase. The last 2 columns show the actual percentage increase in total fruit and the actual increase in total bolls. Most of the increase in total bolls, of course, was caused by maturation of immature fruit already counted on August 1. For the region as a whole, the increase in total fruit amounted to 8.2 percent as compared with the forecast of 7.6 percent made on August 1.

5.4 September 1 Survey

In this survey plant observations were made on the same plots that were laid out on the August 1 survey. The samplers proceeded directly to the sample plots without contacting growers. The plant observations were the same as those made a month earlier except for a few modifications necessitated by the more advanced stage of maturity of the crop.

Open cotton in sample plots was picked and weighed and a handful of the seed cotton from each row was placed in a moisture proof bag and carried to the State office to be weighed before and after drying to determine the moisture percentage. These samples for all fields were composited and weighed before drying. The cotton was then spread out to dry at room temperature for a week and weighed again to determine the moisture loss.

The pertinent data collected on this survey are shown in table 5.9.

Table 5.9--Average September 1 fruit counts and weights of cotton picked in two 10-foot double row plots

State	Burrs	Open and unopened bolls	Small bolls	Blooms	Squares	Percent of full load	Open bolls picked	Field weight of seed cotton per boll	Ratio of air dried weight to field weight
	Number	Number	Number	Number	Number	Percent	Number	Grams	Percent
Ala.	14.4	258.6	41.6	4.8	30.4	100	3697	5.72	90.0
Ark.	5.8	386.2	67.6	13.6	66.4	100	7682	5.71	86.5
Ga.	47.2	221.8	26.9	2.8	53.6	100	8087	5.33	91.6
La.	46.0	269.3	27.5	3.6	43.6	100	7483	5.29	92.4
Miss.	16.9	366.0	31.6	2.8	33.6	100	11402	5.27	90.0
N. C.	0	350.2	48.6	6.4	69.2	99.6	4257	7.18	78.2
Okla.	0	104.6	34.0	4.0	25.2	99.6	756	4.21	91.3
S. C.	36.5	207.5	25.8	1.6	33.6	98.9	6349	5.69	90.0
Tenn.	0	326.7	60.4	8.0	23.2	100	1298	6.38	89.0
Texas	49.1	102.0	38.0	8.0	69.2	98.4	1/8018	1/ 4.04	1/ 95.4

1/ Includes seed cotton picked August 1 in South Texas.

The total bolls per 10 feet of row and the computed September 1 yield forecast are shown in table 5.10.

Table 5.10--Total bolls per 10 feet of row on September 1 and forecast yield per acre

State	Total bolls counted	Total bolls expected	Average seed cotton per boll 1/	Seed cotton per 10 ft.	Conversion factor to lint per acre	Gross yield of lint per acre	Net yield of lint per acre 2/
	Number (1)	Number (2)	Grams (3)	Grams (4)	Pounds (5)	Pounds (6)	Pounds (7)
Ala.	79.8	79.8	5.46	436	1.113	485	436
Ark.	118.3	118.3	4.71	557	1.117	622	560
Ga.	74.7	74.7	5.24	391	1.108	433	390
La.	86.5	86.5	5.00	432	1.006	467	420
Miss.	104.3	104.3	5.07	529	1.106	585	526
N. C.	101.3	102.3	4.55	465	1.022	475	428
Okla.	35.7	36.0	5.67	204	1.074	219	197
S. C.	67.8	69.4	5.06	351	1.101	386	347
Tenn.	98.8	98.8	4.91	485	1.113	540	486
Texas	49.7	52.0	4.23	220	1.087	239	221
10 States	72.1	73.2	4.82	353	1.088	384	350

1/ Average based on 1954 and 1955.
2/ Column (6) less 10 percent except Texas which is 7.5 percent less.

These computations are comparable to those in table 5.5. The number of additional bolls to be produced naturally is much lower on September 1 than on August 1. Although some seed cotton was weighed as of September 1, the 1954-1955 average weight was still used for the September 1 forecast because the season average weight was still unknown for 1956. The net yield shown in the last column of the table was derived from the preceding column by assuming a 10 percent loss in all States except Texas where the loss was assumed to be only 7.5 percent. In most States, the total bolls expected were already present by September 1, but small allowances needed to be made for additional bolls in some areas. These computations were made as on August 1 from a rate of fruiting computation.

The "probability of survival" procedure was also applied to the September 1 data. Squares present on September 1 were not expected to produce cotton except in the high plains of Texas and parts of Oklahoma. On September 1 the "probability of survival" was expected to be as follows for each category of fruit:

Large bolls 1.000

Small bolls ..... .761

Blooms ..... .500

Squares were considered only in Texas and Oklahoma where a survival rate of 23.9 percent was assumed. Yield forecasts from this computation are shown in table 5.11.

Table 5.11--September 1 yield forecast from "Probability of Survival" Model

State	Bolls expected to produce cotton	Average seed cotton per boll 1/	Seed cotton per 10 feet	Conversion factor to lint per acre	Gross yield per acre	Net yield of lint per acre 2/
	Number	Grams	Grams		Pounds	Pounds
Ala.	76.1	5.46	416	1.113	463	444
Ark.	112.6	4.71	530	1.117	592	568
Ga.	72.6	5.24	380	1.108	421	404
La.	84.7	5.00	424	1.080	458	440
Miss.	102.3	5.07	519	1.106	574	551
N. C.	97.8	4.55	445	1.022	455	437
Okla.	34.6	5.67	196	1.074	210	202
S. C.	65.7	5.06	332	1.101	366	351
Tenn.	94.3	4.91	463	1.113	515	494
Texas	50.0	4.23	212	1.087	230	221
10-States	70.5	4.82	340	1.088	370	355

1/ Average based on 1954 and 1955.

2/ Gross yield less 4 percent for seed cotton missed in picking.

5.5 October 1 Survey

Sample fields were visited again as of this date and plant observations made on the same plots. The main purpose of this survey was to count the fruit present on the plants and to obtain weights of open cotton. The data are summarized in tables 5.12 and 5.13. The net yield in the last column of table 5.13 was obtained by assuming a 5.0 percent loss from the gross yield shown in the preceding column.

After all data on the weight of cotton per boll were available, the season average weight was computed. In Texas separate averages were computed for the Eastern and Western portions of the State because boll sizes are quite different in the two areas. It developed that the average boll weight for the Southern region was considerably less than the 1954-55 average that had been used in yield forecasting formulas throughout the season. The data are shown in table 5.14. The first three columns show the weights of cotton picked on September 1, October 1, and the season average. The last column is the unweighted average for the three years, 1954, 1955, and 1956.

Table 5.12--October 1 boll counts and weight of cotton picked in two 10-foot double row plots

State	Burrs	Open and large unopened bolls	Small bolls and blooms	Open bolls picked 1/	Field weight of seed cotton per boll	Ratio of air dried weight to field weight
	Number	Number	Number	Number	Grams	Percent
Ala.	120.0	170.3	8.0	9,179	5.43	96.9
Ark.	193.4	230.2	18.0	15,806	4.62	97.0
Ga.	159.5	96.3	2.8	2,946	4.93	89.9
La.	225.3	112.1	9.6	3,360	5.87	99.6
Miss.	186.5	198.4	10.8	18,497	4.26	97.0
N. C.	127.6	242.2	20.0	10,638	5.56	81.5
Okla.	7.9	88.8	9.6	2,354	4.29	90.3
S. C.	155.6	93.1	8.0	3,854	5.24	79.1
Tenn.	114.7	234.9	8.0	8,389	5.02	95.1
Texas	118.4	74.4	13.4	4,197	4.45	97.8

1/ Total bolls picked in all fields.

Table 5.13--October 1 boll count per 10 feet of row and estimated yield per acre

State	Total bolls expected	Average weight of seed cotton per boll 1/	Weight of seed cotton per 10 ft. row	Conversion Factor Grams of seed cotton to pounds of lint per acre	Gross yield of lint per acre	Net yield
	Number	Grams	Grams		Pounds	Pounds
Ala.	72.6	5.46	396	1.113	441	419
Ark.	105.9	4.71	499	1.117	557	529
Ga.	63.9	5.24	335	1.108	371	352
La.	84.4	5.00	422	1.006	425	404
Miss.	96.2	5.07	488	1.106	540	513
N. C.	92.4	4.55	420	1.022	429	408
Okla.	33.0	5.67	187	1.074	201	191
S. C.	62.2	5.06	315	1.101	347	330
Tenn.	87.4	4.91	429	1.113	477	453
Texas	48.2	4.23	203	1.087	221	210
10 States	66.9	4.82	322	1.088	350	333

1/ 1954-55 average.

Table 5.14--Average dry weight of seed cotton per boll for 1956 season by States

State	September 1	October 1	Season average	Average 1954, 1955 and 1956 season 1/
	Grams	Grams	Grams	Grams
Ala.	5.15	5.26	5.22	5.25
Ark.	4.94	4.48	4.64	4.70
Ga.	4.88	4.43	4.76	5.05
La.	4.89	5.40	5.05	5.05
Miss.	4.74	4.13	4.36	4.70
N. C.	5.61	4.53	4.84	4.80
Okla.	3.84	3.87	3.86	4.75
S. C.	5.12	4.14	4.75	4.90
Tenn.	5.68	4.21	4.89	4.90
Texas	2/ 3.89	4.34	4.40 (3.88 East, 4.92 West)	4.30
10 States	4.46	4.41	4.54	4.75

1/ A straight average of the three years rounded to the nearest 0.05 grams.

2/ Represents cotton picked primarily in East Texas and includes cotton picked on August 1 in South Texas.

5.6 Post-Harvest Surveys

When sample fields were found to have been harvested by farmers a post-harvest interview survey was conducted with the grower, and gleanings were made in the sample field if the field had not already been plowed up. For late harvested fields this survey was not tied to any specific date. Visits were made to sample fields in portions of each State late in the year when cotton was expected to have been harvested. Data obtained in the post-harvest interviews are summarized in table 5.15.

Table 5.15--Post-harvest interview data for sample fields

State	Reported Aug. 1 acres Standing	Percent of acres harv.	Yield: bales per acre	Lbs. of lint per bale	Est. of seed cotton left per acre	Fields reporting	Method of Harvest: Fields with 2 or more methods	Hand: Picked	Hand: Snapped	Machine: Picked	Machine: Stripped or sledded
	Acres	Pct.	Bales	Pounds	Pounds	Number	Number	Number	Number	Number	Number
Ala.	792.6	99.8	.86	501	16	69	1	69	0	1	0
Ark.	3527.9	99.8	1.15	517	39	118	42	104	24	34	1
Ga.	823.1	96.5	.70	525	20	64	0	63	0	1	0
La.	1753.2	95.1	1.02	497	25	58	3	46	0	15	0
Miss.	1790.2	93.7	.93	511	24	112	12	96	2	27	0
N. C.	272.8	96.6	.90	489	33	60	0	60	0	0	0
Okla.	1424.3	96.3	.26	509	60	65	21	22	42	0	22
S. C.	655.1	98.3	.76	456	29	65	0	65	0	0	0
Tenn.	546.9	99.0	1.05	508	14	68	5	65	4	4	0
Texas	13,029.3	98.1	.44	508	17	224	36	37	167	16	42
Region	---	97.6	0.68	506	24	903	120	627	239	98	65

Growers reported that 97.6 percent of the cotton acreage standing on August 1 was harvested. The reported yield per harvested acre for the sample fields was 344 pounds of lint per acre for the region as a whole. Growers estimated that about 10 pounds of lint per acre were missed in picking or left behind in the fields. The first column of the table shows the acres of cotton standing in the sample field as of August 1. The second column shows the percentage of that acreage that was harvested. Reported yields are given in bales in the third column of the table. Reported pounds of lint per bale are given in the fourth column. The farmers' estimate of the amount of seed cotton per acre left behind in the fields during harvesting is given in column 5. The numbers of sample fields harvested by various methods are shown in the last 6 columns.

Post-harvest gleaning data are given in table 5.16. In gleaning cotton remaining in the fields, any cotton that had dropped to the ground was included in each selected sampling unit. Including an estimate of cotton per boll for all unopened bolls, the data in this table show that the bolls and open cotton remaining in the fields represent a dry weight of 131.6 grams of seed cotton per 40 feet of row, including the middle. This is equivalent to 143 pounds of seed cotton or about 53 pounds of lint per acre. 1/

Table 5.16--Post-harvest gleaning data per 40 feet of row, plus middle

State	Fields gleaned	Open bolls	Large unopened bolls	Other bolls dried up or rotten	Weight of seed cotton: In open bolls	Found loose	Total field weight	Total dry weight
	Number	Number	Number	Number	Grams	Grams	Grams	Grams
Ala.	65	20.0	0.4	23.0	37.2	17.1	54.3	47.5
Ark.	74	38.1	1.6	20.8	68.1	45.5	113.6	100.2
Ga.	41	31.5	0.6	22.2	52.1	21.0	73.1	68.7
La.	26	34.6	1.7	16.7	70.0	35.3	105.3	101.6
Miss.	79	31.0	0.9	45.4	56.1	30.4	86.5	79.8
N. C.	47	52.0	0.7	254.3	94.7	48.4	143.1	106.2
Okla.	61	4.7	0.6	4.2	17.7	39.8	57.5	52.8
S. C.	55	23.0	3.4	20.6	39.9	29.3	69.2	63.7
Tenn.	66	21.2	1.5	10.5	41.7	18.7	60.4	52.8
Tex.	95	5.6	1.1	4.8	19.3	17.5	36.8	34.8
10 States	609	18.2	1.2	22.5	37.6	25.3	62.9	57.1

1/ For method of computation, see Report on 1955 Research Surveys, October 1957, Page 42.

6. Objective Corn Yield Studies

6.1 Procedures and Sample Design

A sub-sample of 680 corn fields was selected from among those enumerated in the June 1956 interview survey in the 10 Southern States plus Kentucky and Virginia. Another sample of 680 fields was selected in the 11 North Central States. The fields were allocated to States with regard to the importance of corn acreage in each State, except that the allocation was more arbitrary in the South. The important States in the South were assigned 70 fields each, with the others receiving either 40 or 50 per State. This departure from a straight percentage allocation was made so that the number of fields sampled in each State would be large enough to detect differences in plant behavior between different States. In the North Central States, fields were allocated to States in proportion to the corn acreage reported in the June survey. The number of corn fields selected for observation in each State is shown in table 6.1, together with the numbers on which observations were actually made as of August 1, September 1, October 1 and after harvest.

Table 6.1--Number of corn fields selected by States

Southern States						North Central States					
State	Fields selected	Fields sampled				State	Fields selected	Fields sampled			
		8/1	9/1	10/1	Post harvest			8/1	9/1	10/1	Post harvest
	No.	No.	No.	No.	No.		No.	No.	No.	No.	No.
Ala.	70	69	67	49	51	Ill.	112	18	100	94	76
Ark.	50	40	42	11	31	Ind.	53	9	50	49	24
Ga.	70	66	61	15	19	Iowa	136	22	110	100	90
Ky.	40	38	38	37	16	Kan.	17	4	8	6	8
La.	50	50	45	16	8	Mich.	23	5	22	19	9
Miss.	50	49	48	37	31	Minn.	66	13	66	61	28
N. C.	70	64	63	46	40	Mo.	75	21	70	63	44
Okla.	50	44	17	0	17	Nebr.	65	14	54	48	39
S. C.	50	47	44	17	32	Ohio	47	8	44	43	34
Tenn.	70	67	66	64	56	S. Dak.	51	10	51	43	37
Texas	70	51	28	7	24	Wis.	35	4	34	27	12
Va.	40	36	30	23	6						

In the North Central States, only 1/5 of the fields selected were actually visited as of August 1. Because the crop is considerably later in the North Central States than in the South, it did not appear worthwhile to have as many observations made so early in the season.

As for cotton, growers were interviewed on farms where the sample fields were located at the time of the first visit to obtain their cooperation and to record pertinent data on acreage and expected yields. The sample plots to be used for plant observations were then located in the sample fields and pertinent data on numbers of plants and plant development were recorded. On subsequent visits, samplers proceeded directly to the sample plots for plant observations without contacting the growers. After farmers harvested their fields they were interviewed for data on acreages harvested and estimated yields. Post-harvest gleanings were also made in as many of the sample fields as possible.

Whenever mature corn was found in a sample field, the ears in the sample plots were weighed and sample ears taken from the field for laboratory determinations of shelling percentage and moisture content. In the South these tests were made by agencies within each State in the program. In the North Central States sample ears from all States were sent to a central laboratory at Iowa State College. The work in the North Central States was concerned with forecasts and estimates of corn quality, as well as with forecasts and estimates of yield. Plant observations and laboratory tests on sample ears in the North Central States were more extensive than in the South because of this aspect of the work. The results from the yield studies are described in the next four sections of this chapter. The results from the quality studies in the North Central States are described in the last section.

6.2 August 1 Survey

Operators of farms on which the sample fields were located were interviewed at the time of this interview to obtain data on corn acreage, utilization and expected yields. In the North Central States only 1/5 of the total fields selected were contacted on August 1. All of the selected fields were visited in the South. Results of the farm interview are summarized in table 6.2.

Table 6.2--August 1 farm interview data for sample fields

Items	Southern States	North Central States
	Per field	
Acres planted - reported in June	16.9	32.4
Acres planted - August 1	14.4	32.0
Net acres in corn - August 1	13.8	31.2
Acres for grain - August 1	12.9	28.4
Yield per acre for grain (bushel)	34.6	55.8

This table shows the farm interview data that applies to the sample fields on a per field basis. Comparisons are given between the acres reported as planted to corn in the June survey, the acres found to be planted at the time of the August 1 survey, the net acres actually in corn as of August 1, the acres intended for grain, and the farmer's appraisal of yield per acre for the corn intended for grain in the sample field.

In each sample field, two plots were selected for observation. Each plot consisted of two double 15-foot row sections. In fields that were power checked or hill dropped, 15 feet were measured from a starting point parallel to the direction of the hills corresponding to the direction in which the sampler had been walking. The first plot in each field was located by a pair of numbers representing the rows to be counted along the edge of the field and the number of paces or steps to be taken into the field. These numbers were supplied to the samplers before they began their work. When there was no definite direction to the rows, or when it was impossible to count rows, an equal number of paces was substituted for the row count. The second sample plot in each field was selected by proceeding 30 rows and 30 paces farther into the field.

The following information was recorded for each sample plot:

(1) Distance across 4 row spaces.

(2) Plant and fruit counts in the entire plot.

a. Number of stalks.
b. Number of stalks having ears or silked ear shoots.
c. Number of ears or silked ear shoots.
d. (If no ears or silked ear shoots are present): number of stalks with tassels visible.

(3) Observations on the first 5 ears on plants beyond row 1 in plot 2.

a. Observed stage of maturity of each ear.
b. Estimated percent fill for each ear.

(4) Observations on an entire 15-foot row section in row 1 of plot 2.

a. Length and circumference of each ear or ear shoot in the row section.
b. Number of ears or silked ear shoots expected to produce no grain.
c. Number of unsilked ear shoots.

(5) (If the corn is ripe): counts of ears and weight of husked ears, weights being recorded for each 15-foot row section as a whole.

The results of these observations are summarized in tables 6.3 for the Southern States and 6.4 for the North Central States.

Table 6.3--Average August 1 counts in 2 sample plots, by maturity categories -- 12 Southern States

Item	Stage of Maturity					
	No shoots formed	Shoots starting to silk	Silking nearly completed	Ears formed	Ears ripe	All stages
Number of fields sampled	73	58	165	316	9	621
Width across 8 row spaces (feet)	27.3	28.4	27.1	28.2	25.7	27.8
Number of stalks per 60 feet of row	25.8	31.6	29.5	27.3	25.7	28.1
Number of stalks with "ears"	0	7.3	25.1	25.1	17.6	20.1
Number of ears and silked shoots	0	10.2	40.2	38.4	20.8	31.0
Number of stalks with tassels	3.2	--	--	--	--	--
Maturity classification of 5 ears:						
Mature	0	0	0	0.1	4.7	.2
Dent	0	0	0	1.6	0	.8
Dough	0	0	.1	1.4	0	.7
Milk	0	0.1	.6	1.5	.1	.9
Earlier milk	5	4.9	4.2	0.5	.2	2.4
Percent fill	--	--	--	76.4	62.3	--
Ear measurements in 15-foot section:						
Total length (inches)	--	--	--	63.9	30.4	63.0
Total circumference (inches)	--	--	--	56.7	23.9	55.8

Table 6.4--Average August 1 counts in 2 sample plots by maturity categories -- 11 North Central States

Item	Stage of Maturity					
	No shoots formed	Shoots starting to silk	Silking nearly completed	Ears formed	Ears ripe	All stages
Number of fields sampled	28	30	63	7	0	128
Width across 8 row spaces (feet)	26.1	26.7	26.7	25.9	--	26.5
Number of stalks per 60 feet of row	43.5	48.8	53.4	51.4	--	50.1
Number of stalks with "ears"	0	10.7	44.5	48.9	--	27.1
Number of ears and silked shoots	0	12.3	55.3	67.9	--	33.8
Number of stalks with tassels	12.4	--	--	--	--	--
Maturity classification of 5 ears:						
Mature	0	0	0	0	--	0
Dent	0	0	0	.7	--	.05
Dough	0	0	0	.9	--	.05
Milk	0	0	0.3	2.7	--	.30
Earlier milk	5.0	5.0	4.7	.7	--	4.60
Percent fill	--	--	--	84.9	--	--
Ear measurements in 15-foot section:						
Total length (inches)	--	--	--	120.8	--	120.8
Total circumference (inches)	--	--	--	95.6	--	95.6

Data collected as of August 1 in the Southern States during 1955 were analyzed to develop a formula for forecasting the total number of ears to be formed from an August 1 ear count. For the Southern region as a whole, the 1955 August 1 ear count did not differ much from the count obtained later in the season just prior to harvest. However, in late maturing States, such as Tennessee, the August 1 count needs to be adjusted for ears still to be produced. Data obtained in Tennessee for 1955 indicated a linear relationship between the total number of ears already present on August 1 and the fraction of stalks having ears on August 1. But the adjustment in Tennessee was so small that it had very little effect on the region as a whole. For all practical purposes, an August 1 ear count in the Southern region reflects the ear count at harvest time quite accurately. However, the relations found in Tennessee were applied to August 1 counts made in the North Central States in 1956. An estimate of the number of ears to be found in the North Central States at harvest time was computed by assuming a linear relationship between the fraction of the total ears already present by August 1 and the fraction of stalks having ears on August 1.

As 1955 studies in the South also indicated that only about 90 percent of the stalks had ears at harvest time, it was assumed that only about 90 percent of the stalks in the North Central States would have ears at harvest time. The August 1 data for the North Central States in table 6.4 thus indicated the total number of ears at harvest time to be $\frac{50.1}{27.1} \times 33.8 \times 0.90 = 56.2$ ears per 60 feet of row. As there were 50.1 stalks per 60 feet of row but only 27.1 already had ears as of August 1, it was assumed that the 33.8 ears per 60 feet of row already present would represent only 27.1/50.1 of the total potential ear load. But as only 90 percent of the stalks are expected to produce ears, the potential given by the ratio of stalks to stalks with ears must be reduced by 10 percent. All of these factors are included in the above computation. An alternative method of forecasting the number of ears expected at harvest time can also be applied. Studies in previous years indicated that about 1.1 ears are produced per stalk. Applying this factor to the stalks counted in 1956, indicates 30.9 ears per 60 feet of row in the South and 55.1 in the North Central States. These estimates agree closely with the 31.0 and 56.2 obtained by the previous method. Further studies of these relationships still need to be made, particularly with regard to possible variation in the observed relationships between States.

To arrive at a yield forecast it is also necessary to forecast the amount of grain to be produced per ear. In most of the South the development of ears by August 1 is sufficiently advanced so that the mature ear size can be determined fairly accurately. But in the North Central States many ears are still so immature on August 1 that the mature size can not be forecast so precisely. Preliminary studies of data obtained in earlier studies suggest that it may be possible to forecast the average weight per mature ear from the number of ears expected to be formed.

6.3 September 1 Survey

The same sample plots were visited again as of this date for observations similar to those made on August 1. In the North Central States the 80 percent of the total sample that was not contacted in August was visited at this time and operators of the farms on which those sample fields were located were interviewed.

These interviews were identical with those conducted as of August 1. Two sample ears were also harvested in each field in the North Central States at this time and sent to the laboratory at Iowa State College for laboratory analysis. Immature ears were picked, as well as mature ears, because of the corn quality work that formed a part of this project in the North Central States. The results of the farm interviews conducted in the North Central States are summarized in table 6.5. The data reported by the farmers that were interviewed as of September 1 agree closely with those reported for the North Central States in August 1 interviews. The results from the field observations in the sample plots are given in table 6.6. A September 1 yield forecast would be derived from such data by applying an estimated weight of grain per ear to the ear count. 1954 and 1955 data collected in the South indicated that every inch of ear length on immature ears, as measured over the husks, was equivalent to 0.045 pounds of ear corn at 15.5 percent moisture. For ripe corn each inch of ear length represented 0.053 pounds of ear corn.

Although the sample was not intended to provide estimates by individual States, yield computations were made for individual States from these relationships as a matter of general interest. The estimated weight of ear corn per 60 feet of row, the conversion factor for converting that weight of ear corn to bushels of grain per acre and the net yield obtained by assuming a 10 percent harvesting loss are shown in table 6.7 for individual States.

Table 6.5--September 1 farm interview data for remaining sample fields in North Central States

Items	Per field
Acres planted - reported in June	31.2
Acres planted - September 1	30.5
Net acres in corn - September 1	28.6
Acres for grain - September 1	26.5
Yield per acre for grain (bushels)	55.6

Detailed stalk and ear counts are also shown by States in table 6.8.

Table 6.6--Average September 1 counts in 2 sample plots

Item	Southern States	North Central States
Number of fields sampled	617	609
Width across 8 row spaces (feet)	27.8	26.3
Number of stalks per 60 feet of row	24.4	52.7
Number of stalks with "ears"	22.1	48.7
Number of ears & silked shoots	30.8	58.8
Number of ears or shoots not expected to produce grain	3.9	10.7
Maturity Classification of 5 ears:		
Mature	2.1	.3
Dent	1.6	1.3
Dough	.7	1.5
Milk	.4	1.4
Earlier Milk	.2	.5
Percent fill	66.0	78.9
Ear measurements in 15-foot section:		
Total length (inches)	50.2	119.3
Total circumference (inches)	46.5	93.7

Table 6.7--September 1 forecast of weight of corn per 60 feet of row and yield per acre

State	Southern States: Ear corn per 60 feet 1/	Factor to convert to gross yield per acre 2/	Net yield per acre	State	North Central States: Ear corn per 60 feet 1/	Factor to convert to gross yield per acre 2/	Net yield per acre
	Pounds		Bushels		Pounds		Bushels
Ala.	9.43	2,920	24.7	Ill.	23.0	3.030	62.7
Ark.	6.87	3.050	18.9	Ind.	20.5	3.039	56.1
Ga.	10.90	2.960	29.1	Iowa	22.6	3.028	61.6
Ky.	14.19	2.985	38.2	Kan.	11.8	3.002	31.9
La.	16.40	2.265	33.4	Mich.	22.0	3.093	61.2
Miss.	8.71	3.065	24.0	Minn.	24.7	3.068	68.2
N. C.	15.59	2.723	38.3	Mo.	21.0	3.095	58.5
Okla.	8.36	3.060	23.0	Nebr.	12.4	3.004	33.5
S. C.	9.05	2.732	22.2	Ohio	29.7	3.062	81.8
Tenn.	11.51	3.020	31.3	S. Dak.	16.6	3.019	45.1
Texas	7.68	3.125	21.6	Wis.	24.9	3.138	70.3
Va.	15.15	2.900	39.5				
Region	11.20	2.928	29.5	Region	21.5	3.074	59.5

1/ Weight at 15.5% moisture.
2/ A 78% shelling percentage was assumed for all States.

Table 6.8--Average September 1 counts in 2 sample plots

State	Sample fields	No. of stalks	No. of stalks with ears	No. of ears	No. of ears not expected to produce grain	State	Sample fields	No. of stalks	No. of stalks with ears	No. of ears	No. of ears not expected to produce grain
Ala.	67	25.9	23.6	31.1	3.8	Ill.	100	53.3	51.4	61.7	11.7
Ark.	42	21.7	18.6	25.2	6.4	Ind.	50	49.3	47.1	57.6	9.7
Ga.	61	26.0	23.6	35.7	4.9	Iowa	110	60.2	54.7	60.1	8.4
Ky.	38	32.2	30.1	37.3	4.0	Kan.	8	36.4	30.5	33.8	0
La.	45	41.3	37.1	45.6	2.7	Mich.	22	50.2	48.8	62.1	9.3
Miss.	48	27.4	24.0	29.8	2.7	Minn.	66	57.5	56.3	77.1	16.4
N. C.	63	32.0	30.2	48.9	4.4	Mo.	70	53.8	46.7	56.7	2.0
Okla.	44	28.7	22.0	27.3	4.5	Nebr.	54	37.3	30.3	39.2	10.4
S. C.	48	26.7	24.8	33.6	6.0	Ohio	44	50.3	46.3	59.8	17.3
Tenn.	66	28.0	25.2	35.2	3.8	S.Dak.	51	42.0	39.2	46.6	10.7
Texas	54	24.7	21.1	26.5	3.6	Wis.	34	67.0	57.8	68.4	16.6
Va.	30	35.3	34.7	51.3	11.7						

The yield forecasts in table 6.7 were computed from the ear counts and ear lengths. The weight of ears per inch was computed from current data, using weights and lengths of ears that had already reached maturity by September 1. Such a procedure would appear to be logical and fairly easy to apply in an operational program. However, data collected as part of the corn quality studies suggest the possibility of another approach. Moisture determinations on a large number of immature ears indicate that the fraction of the total dry matter that has already been laid down in an ear is related to the ratio of dry kernel weight to wet kernel weight. Although these percentages are not equal to each other, they do seem to bear a close relationship to each other:

Dry kernel weight/wet kernel weight	Fraction of dry matter laid down
Percent	Percent
0	0
10	5
20	15
30	30
40	45
50	65
60	85
70	95
80	100

In other words, as soon as the moisture content of immature corn is known, the weight of the dry matter already present can be converted to an estimate of the total weight of all dry matter when the corn reaches maturity.

Pertinent ear characteristics are given for individual States in table 6.9.

Table 6.9--Average September 1 characteristics and forecast weight per ear

State	Circumference of ear	Length of cob	Average length of kernel rows	Wet weight of ear	Wet weight of kernels	Weight of kernels at 15.5% moisture	Expected weight of kernels at harvest at 15.5% moisture
	Inches	Inches	Inches	Grams	Grams	Grams	Grams
Ill.	6.5	9.4	8.3	388.9	282.2	174.6	226.7
Ind.	5.9	9.0	7.6	307.5	185.5	96.1	188.5
Iowa	5.8	8.7	7.1	293.4	200.9	71.9	182.6
Kan.	5.7	8.3	6.8	209.2	154.1	141.1	144.0
Mich.	5.5	8.2	6.8	242.5	132.6	41.9	190.2
Minn.	5.7	8.1	6.8	270.8	175.6	82.4	171.8
Mo.	6.4	9.5	8.3	354.9	256.1	185.0	198.9
Nebr.	4.5	6.9	4.7	174.7	114.4	65.0	104.9
Ohio	5.1	8.2	6.4	233.7	135.7	54.4	217.5
S. Dak.	5.3	8.1	6.3	230.7	136.8	51.7	152.0
Wis.	4.6	7.8	6.0	148.0	55.9	57.3	220.4
Region	5.8	8.6	7.1	290.6	193.3	106.4	186.4

6.4 October 1 Survey

The same plots in the fields were visited again as of this date for similar observations made the previous month. Fields which had already been found to be harvested as of September 1 were not revisited. Two sample ears were again harvested in each field in the North Central States and sent to the laboratory at Iowa State College for laboratory analysis and observations on ear and grain characteristics.

Pre-harvest weights of corn were obtained in all fields still remaining for harvest in the South. These pre-harvest yield indications are given for all States in that region in table 6.10. A 10 percent harvesting loss was assumed in arriving at net yield estimates.

Table 6.10--October 1 data for 2 sample plots harvested--Southern States 1/

State	Item					Net yield
	Fields	Ears with grain	Field weight of ear corn	Shelling percent	Moisture content	
	Number	Number	Pounds	Percent	Percent	Bushels
Ala.	68	24.8	8.68	80.7	25.1	23.2
Ark.	37	20.5	7.82	74.7	24.1	20.5
Ga.	58	30.4	11.52	81.9	21.9	33.1
Ky.	37	31.4	18.11	76.9	23.6	48.2
La.	40	41.3	17.58	83.2	14.4	43.0
Miss.	46	27.6	9.05	80.8	22.1	26.5
N. C.	62	39.7	18.10	81.7	23.4	46.8
Okla.	44	25.4	8.08	69.8	17.9	21.3
S. C.	42	27.8	8.66	79.8	20.5	22.8
Tenn.	64	31.3	14.24	79.6	22.0	40.5
Texas	26	26.4	10.32	79.3	23.4	29.7
Va.	26	33.1	21.92	79.7	27.1	56.0
Region	550	30.2	12.86	79.9	22.8	31.7

1/ Includes plots which were ripe and harvested on September 1.

Detailed data on characteristics of selected sample ears are shown in table 6.11

Table 6.11--Ear characteristics of sample ears--Southern States

State	Circumference	Length	Weight of kernels per ear at 15.5%	Weight of kernel per inch of ear	Weight of kernels per inch of ear	Weight of ear per inch of length
	Inches	Inches	Grams	Grams	Pounds	Pounds
Ala.	5.6	6.8	116.7	17.3	.038	.047
Ark.	5.3	6.6	106.6	16.1	.035	.047
Ga.	5.3	6.5	129.7	20.0	.044	.054
Ky.	6.1	7.3	182.6	25.0	.055	.071
La.	5.7	6.9	149.0	21.5	.047	.057
Miss.	5.5	6.3	111.4	17.7	.039	.048
N. C.	5.9	7.3	171.5	23.5	.052	.064
Okla.	5.6	6.9	113.1	16.4	.036	.052
S. C.	5.2	5.8	102.8	17.7	.047	.059
Tenn.	5.7	6.8	145.2	21.5	.047	.060
Texas	5.3	6.1	101.6	16.7	.037	.047
Va.	6.7	8.4	225.5	26.8	.059	.074
Region:	5.6	6.8	137.7	20.4	.045	.056

The relationship of weight of corn to ear length measured over the husks, computed for the Southern States from 1954-1955 data, was used to compute October 1 yield indications for the North Central States. These computations are shown in table 6.12.

Table 6.12--October 1 forecast of weight of corn per 60 feet of row and yield per acre--North Central States

State	Stalks per 60 feet	Ears per 60 feet	Total length of ears in 60 feet	Pounds of ear corn per 60 feet (15.5% moisture)	Net yield
	Number	Number	Inches	Pounds	Bushels
Ill.	53.4	60.1	461.6	22.7	61.8
Ind.	48.0	54.3	395.4	17.8	48.7
Iowa	58.8	55.7	450.0	20.2	55.2
Kan.	36.0	34.1	269.5	12.1	32.8
Mich.	52.3	61.8	432.3	19.4	54.2
Minn.	56.8	69.7	477.4	21.5	59.3
Mo.	53.7	52.4	412.0	18.5	51.7
Nebr.	33.7	32.7	237.8	10.7	28.9
Ohio	51.6	61.3	471.8	21.2	58.5
S. Dak.	41.5	41.1	301.7	13.6	36.9
Wis.	66.1	65.6	590.8	26.6	75.1
Region	51.8	54.9	420.8	21.4	59.2

The results of observations on sample ears at the Iowa State College Laboratory are given in table 6.13.

Table 6.13--October 1 ear characteristics and forecast weight per ear--North Central States

State	Circumference	Length	Length of kernel rows	Wet weight of ears	Wet weight of kernels	Weight of kernels at 15.5% moisture	Expected weight of kernels at harvest at 15.5% moisture
	Inches	Inches	Inches	Grams	Grams	Grams	Grams
Ill.	6.7	8.7	7.9	332.8	266.2	234.8	239.6
Ind.	6.5	8.7	7.7	338.9	258.8	203.9	213.5
Iowa	6.0	8.0	7.0	268.8	210.1	171.8	177.0
Kan.	5.6	7.7	6.8	184.5	150.0	153.5	153.5
Mich.	6.0	7.9	6.3	277.2	192.4	128.4	156.6
Minn.	6.3	8.1	7.2	306.5	232.8	173.7	184.8
Mo.	6.2	8.9	7.8	302.6	238.7	216.7	216.7
Nebr.	5.0	6.4	5.0	183.2	141.3	133.1	135.7
Ohio	5.8	7.7	6.5	294.6	219.0	148.0	164.5
S. Dak.	5.8	7.4	6.3	210.5	158.0	127.6	131.5
Wis.	6.3	8.8	7.7	351.0	258.6	166.1	211.6
Region	6.1	8.1	7.0	288.2	222.9	179.7	189.3

The expected weight of the grain at harvest time was computed from the relationship between the moisture content and the percentage of total dry matter that was laid down by the time the given moisture content was reached. The final weight of the corn as projected in these computations does not differ greatly from the weight that was expected from similar data as of September 1.

By October 1 most of the corn in the North Central States had reached maturity although an appreciable fraction of the acreage in Minnesota, Wisconsin and Ohio was still not mature. A number of immature fields in Minnesota, Michigan and Wisconsin were caught and damaged by killing frosts during September and were generally utilized for silage or other non-grain purposes. In terms of State average yield, the loss of dry matter caused by the killing frost was small but, for the particular fields affected, the loss amounted to as much as 1/3 of the potential yield. Laboratory analysis of sample ears indicated little evidence of damage. The quality of the crop standing in the fields as of October 1 appeared excellent with only a few traces of grain deterioration or discolored kernels being found in Missouri and Ohio.

6.5 November 1 Survey

This survey was made only in the North Central States and was included in the project because it was believed that some fields would not be harvested before that date. However, it was found that most of the fields had been harvested and that pre-harvest observations could be made in only 97 fields. Pre-harvest yield data obtained on this survey were combined with pre-harvest data obtained from mature fields on previous visits, with a summary of all results being given in table 6.14. A 10 percent harvesting loss was assumed in arriving at the net yield. A summary of the weight of grain per ear for sample ears sent to the laboratory is given in table 6.15 for mature ears.

Table 6.14--1956 data for 2 sample plots harvested at maturity--North Central States

State	Plots harvested Nov. 1			All Plots harvested during season					
	Fields	Ears with grain	Field wt. of ear corn	Fields	Ears with grain	Field wt. of ear corn	Shelling percent	Moisture content	Net yield
	Number	Number	Pounds	Number	Number	Pounds	Percent	Percent	Bushels
Ill.	5	36.2	19.1	97	51.9	36.6	80.1	24.1	92.1
Ind.	8	46.8	25.9	47	45.9	33.4	77.7	29.6	75.8
Iowa	5	50.2	30.2	72	54.0	32.4	78.9	27.4	76.8
Kan.	0	--	--	6	30.5	11.8	82.2	11.5	35.2
Mich.	0	--	--	13	51.8	35.6	74.3	32.5	75.4
Minn.	29	55.9	27.1	39	54.9	28.1	78.3	23.6	70.4
Mo.	7	43.4	27.3	63	51.1	30.5	79.3	21.4	80.4
Nebr.	1	37.0	18.3	45	29.5	22.3	74.7	26.1	50.5
Ohio	28	46.2	22.5	37	46.6	25.7	77.7	28.7	59.6
S. Dak.	0			29	41.3	18.2	74.6	26.5	41.1
Wis.	14	60.0	34.1	21	61.8	38.1	78.9	26.6	94.5
Region	97	50.5	26.3	469	48.7	30.5	78.3	25.3	74.9

Table 6.15--Grain weight of mature ears--North Central States

State	September 1		October 1		November 1		Season	
	Fields	Kernel weight per ear (15.5%)	Fields	Kernel weight per ear (15.5%)	Fields	Kernel weight per ear (15.5%)	Fields	Kernel weight per ear (15.5%)
	Number	Grams	Number	Grams	Number	Grams	Number	Grams
Ill.	9	237.1	89	235.9	4	235.0	102	236.1
Ind.			41	216.0	9	191.9	50	211.6
Iowa			80	176.1	5	232.9	85	179.4
Kan.	3	155.5	3	151.6			6	153.5
Mich.			11	150.4	7	145.3	18	148.4
Minn.			19	177.0	28	188.7	47	184.0
Mo.	22	205.8	48	221.7			70	216.7
Nebr.	2	199.7	33	148.0	1	210.5	36	152.6
Ohio			9	199.8	28	154.3	37	165.3
S. Dak.			29	125.3			29	125.3
Wis.			3	243.0	13	166.8	16	181.1
Region	36	209.1	365	194.8	95	177.1	496	192.8

6.6 Post-Harvest Survey

Results of the interview with farmers after they had harvested the crop are shown in table 6.16 for the Southern States. This table provides information on the acreage standing in the sample fields as of August 1, the percent that was harvested, and the yield for harvested acreage, together with information on method of harvesting. In Texas the acres reported as "harvested" exceeded the average reported as "standing on August 1". The growers' estimate of the amount of corn left behind in the field in the harvesting operation and the numbers of fields grazed by livestock after harvest are also included. Post-harvest gleaning data for the sample fields are given in table 6.17.

Table 6.16--Post-harvest interview data for sample fields--Southern States

State	Reported Aug. 1 sample acres standing	Percent of acres harvested	Yield per acre harvested for grain	Method of harvesting: Hand pulled	Hand picked	Picked from shock	Machine picked	Growers' estimate of bu. left per acre	Grazed by livestock: Yes	No
	Acres	Percent	Bushels	Fields	Fields	Fields	Fields	Bushels	Flds.	Flds.
Ala.	958	97.0	22.3	29	10	1	15	1.3	11	44
Ark.	296	100.0	19.1	27	3	0	3	1.9	19	14
Ga.	876	89.4	26.3	23	0	0	21	1.7	17	24
Ky.	498	96.2	46.5	7	6	3	15	2.1	12	19
La.	560	100.0	36.4	38	0	0	10	5.4	16	32
Miss.	524	94.5	24.9	39	0	0	5	0.8	20	23
N. C.	344	99.1	46.5	32	0	2	17	2.8	5	44
Okla.	451	98.4	28.3	8	3	0	18	1.1	3	26
S. C.	1143	100.0	19.8	17	2	1	16	2.0	5	31
Tenn.	968	98.9	36.2	36	0	3	22	0.8	11	49
Texas	899	102.0	21.1	23	3	0	20	1.3	22	23
Va.	133	97.7	52.4	2	5	4	5	2.3	4	11
Region pooled	7650	97.7	30.9	281	32	14	167	1.6	145	340

Table 6.17--Post-harvest gleaning data for sample fields, per 60 feet of row and middle--Southern States

State	Ears on plants	Ears on ground	Weight of kernels from ears	Weight of loose grain	Weight of all kernels	Moisture content	Bushels gleaned per acre
	Number	Number	Grams	Grams	Grams	Percent	Bushels
Ala.	1.3	0.6	151.6	31.2	182.8	15.4	1.5
Ark.	1.2	0.8	90.3	0.1	90.4	14.6	0.8
Ga.	2.3	2.6	258.6	35.0	293.6	13.6	2.5
Ky.	0.8	1.3	252.0	134.4	386.4	20.2	3.1
La.	1.6	0	112.3	9.3	121.6	16.1	0.8
Miss.	2.5	0.9	146.1	49.5	195.6	15.1	1.7
N. C.	3.0	4.1	400.5	76.2	476.7	16.4	3.6
Okla.	0.3	0.5	40.1	86.5	126.6	15.1	1.1
S. C.	4.1	2.1	251.3	31.7	283.0	15.2	2.2
Tenn.	1.8	1.2	153.5	51.2	204.7	18.1	1.7
Texas	1.7	1.4	105.6	32.9	138.5	11.0	1.3
Va.	1.0	2.0	343.3	98.5	441.8	20.7	3.4
Region pooled	2.3	1.8	207.8	51.2	259.0	15.3	2.1

Corresponding results from the post-harvest interviews and post-harvest field observations made in the North Central States are shown in tables 6.18 and 6.19. The objective gleaning data were used to derive estimates of the numbers of bushels per acre left behind in the fields in terms of the standard moisture content of 15.5 percent. Average gleanings were about 6 percent of the total production in the South and about 7 percent in the North Central States. In the South gleaning was highest in North Carolina, South Carolina and Georgia in terms of percent of gross yield. In the North Central States gleanings were highest in the western part of the region: 13.1 percent in Kansas, 10.0 percent in Missouri and 9.7 percent in Nebraska.

Table 6.18--Post-harvest interview data for sample fields--North Central States

State	Sept. 1 sample acres standing	Percent of acres harvested	Yield per acre harvested for grain	Method of harvesting				Growers' estimate of bu. left per acre	Grazed by livestock	
				Hand pulled	Hand picked	Picked from shock	Machine picked		Yes	No
	Acres	Percent	Bushels	Fields	Fields	Fields	Fields	Bushels	Flds.	Flds.
Ill.	3446	99.1	76.3	0	0	0	74	2.8	19	79
Ind.	1230	99.2	68.6	0	0	0	38	2.1	15	33
Iowa	3254	98.7	55.1	0	0	0	104	3.5	48	56
Kan.	146	73.3	27.4	0	0	0	8	3.4	1	7
Mich.	279	96.1	58.2	0	0	0	17	3.4	0	17
Minn.	1822	97.0	61.1	0	0	0	57	2.9	17	42
Mo.	3147	98.9	63.5	2	1	1	63	2.9	8	60
Nebr.	1481	90.3	28.4	1	1	0	45	1.7	25	21
Ohio	678	97.1	67.8	1	1	1	39	1.5	5	36
S. Dak.	1662	98.1	30.9	0	0	0	43	2.9	22	20
Wis.	494	90.5	83.7	0	0	0	26	2.6	15	11
All States	17,639	97.4	59.5	4	3	2	514	2.7	175	382

Table 6.19--Post-harvest gleaning data for sample fields, per 60 feet of row and middle--North Central States

State	Ears on plants	Ears on ground	Weight of kernels from ears	Weight of loose kernels	Weight of all kernels	Moisture content	Bushels gleaned per acre
	Number	Number	Grams	Grams	Grams	Percent	Bushels
Ill.	1.2	1.5	365.5	422.4	787.9	13.8	6.9
Ind.	1.3	1.7	417.1	201.4	618.5	15.8	5.3
Iowa	1.0	3.1	471.2	199.4	670.6	17.2	5.6
Kan.	0.3	4.6	429.1	148.8	577.9	7.7	5.3
Mich.	1.1	8.0	94.6	453.9	548.4	17.8	4.6
Minn.	0.4	3.3	560.0	152.4	712.5	13.0	6.4
Mo.	1.0	3.4	642.7	360.2	1002.8	13.5	8.9
Nebr.	2.2	4.2	319.7	315.8	635.5	16.4	5.4
Ohio	1.0	2.6	211.8	344.8	556.6	22.3	4.4
S. Dak.	0.8	2.8	308.0	114.3	422.2	14.8	3.6
Wis.	2.1	2.1	155.8	121.5	277.3	22.5	2.3
All States	1.2	3.0	402.4	274.3	676.7	15.9	5.8

6.7 Corn Quality Studies

These studies were an important part of the corn work in the North Central States. Field observations required were made at the same time observations were taken for the objective yield work on the same sample of fields. Visits to sample fields were made as of August 1, September 1, October 1 and November 1. The number of fields selected is shown in table 6.1. However, only about a 20 percent subsample was contacted on the August 1 visit as described in the yield studies.

In this study "corn quality" refers to observable characteristics of the grain without any attempt being made to assay feeding value by direct experiment. The degree to which feeding value is actually affected by damage to the grain during the growing period or by frost damage before the crop is entirely matured is not clearly established. Many people believe that soft corn, when dried artificially before storage or when chopped for silage, has almost the same feeding value as corn maturing prior to a killing frost. However, soft corn is customarily regarded as being of poor quality by the corn trade.

The studies on the appraisal of corn quality during the crop season had two main objectives: (1) plotting the trend in proportion of fields (acreage) which would reach maturity by specific dates as forecast from the silking rate prior to August 1, and as forecast again from the stage of development and moisture content on September 1, and (2) observing quality characteristics of the grain by taking samples of ears on each monthly visit, starting September 1, and subjecting the grain to laboratory study. The laboratory tests were made at a central laboratory at Iowa State College. Two ears from each sample field were sent to the laboratory each month starting September 1. The moisture content was measured for all corn, regardless of stage of maturity. Kernels showing discoloration or the effects of weevil, earworm, or disease damage were separated from sound kernels and separate weights obtained for sound and damaged grain for each sample field.

A month-by-month record was kept of amount of damaged grain found and of average moisture and dry matter percentages. Records of this kind should make it possible, as of any date, to forecast the characteristics of the crop at harvest time by projecting the trends. Past weather records, which indicate the potential early-frost hazard, can be used in connection with charts showing rates at which the crop is approaching maturity, to give monthly indications of the percent of the total crop that is in danger of being hit by frost before reaching maturity.

In practically all States, plant and ear development were sufficiently advanced by August 1 so that little or no frost damage was anticipated. Chart 2 shows the fraction of the acreage expected to reach maturity by specified dates as forecast from August 1 observations. Chart 1 was used to derive the maturity date for each field (i.e., the date maximum dry matter content should be attained). The data for each field used in Chart 2 were related to the average date of first killing frost for the particular county in which the sample field was located. These data are shown in Chart 3.

Chart 2 indicated that about 6 percent of the acreage would be safe from a killing frost by September 1, 70 percent by October 1, and the entire acreage by mid-October. Late September is the critical time when the bulk of the crop is maturing. The curve in Chart 3 (at the point X = 0) indicates that about 82 percent of the acreage was expected to "mature" prior to the first killing frost.

Chart 4 was derived to show the amount by which yield would be reduced for fields not reaching maturity by the normal date of first killing frost. With the help of this chart it was possible to estimate that yield on the 18 percent of the acreage which was not expected to mature before the first killing frost would be reduced approximately 2 percent. In terms of the total acreage, this would represent a reduction of only 2 x .18, or 0.4 percent in the average yield for the entire region. From a practical point of view, one would conclude on August 1 that, if the 1956 season was normal after that date, the average yield would not be affected much by frost. However, Chart 3 makes it possible to speculate on the effect of a killing frost occurring one week earlier than normal over the entire region. Such an early frost would affect an additional 24 percent of the acreage. This would reduce yields by 6.4 percent on the acreage affected and by 2.7 percent for the entire region as a whole.

By September 1, potential losses from frost were lower for the Belt as a whole than indicated on August 1. Nevertheless, in Minnesota, Michigan, South Dakota, Nebraska, Ohio, and Wisconsin, significant acreages were not expected to mature by the normal date of first killing frost. However, the potential loss of dry matter which might occur on such acreages was expected to be quite small.

Ear samples taken on September 1 indicated little or no grain damage from insects. Observed amounts of deteriorated or discolored grain on sample ears were less than one-half of one percent by weight in all States. Small quantities of damaged kernels were found in Illinois, Iowa, Minnesota, Missouri, Nebraska and South Dakota. In general, there was little evidence on September 1 of possible serious damage to the crop from any source, provided frosts would occur on normal dates.

Detailed data on grain damage and moisture content are given in table 6.20.

As of October 1, 70 percent of the acreage in the Belt was safe from frost, but over half of the acreage in Minnesota, Ohio, and Wisconsin was still not mature. A number of immature fields in Minnesota, Michigan, and Wisconsin were caught and damaged by killing frosts during September; these were generally utilized for silage or purposes other than grain. The loss of dry matter caused by frost, in general, was small, but for individual fields losses were as much as one-third of the expected yield. The remainder of the acreage was expected to mature by mid-October.

The extent of damage to kernels and ears in shown in table 6.21. Damage was so negligible that the quality of the crop would be considered excellent.

Table 6.20---Percent of total ears showing damage, percent of damaged kernels by weight, and moisture content of kernels, for ears in various stages of development--September 1, 1956

State	Stage of development											
	Mature			Dent			Dough			Milk		
	% ears	% weight	Moisture content	% ears	% weight	Moisture content	% ears	% weight	Moisture content	% ears	% weight	Moisture content
Illinois	0	0	30.3	2.1	0.5	43.9	0	0	54.1	0	0	71.2
Indiana	-	-	-	0	0	46.6	0	0	51.1	0	0	72.0
Iowa	-	-	-	0	0	50.2	5.5	0.5	57.9	0	0	68.1
Kansas	0	0	11.1	0	0	23.2	0	0	54.2	-	-	-
Michigan	-	-	-	-	-	-	0	0	54.2	0	0	76.2
Minnesota	-	-	-	6.3	1.1	48.7	0	0	57.2	1.4	0.2	67.7
Missouri	2.3	0.3	28.2	3.2	0.5	39.6	0	0	49.5	-	-	-
Nebraska	25.0	0.1	38.4	5.0	0	44.9	2.6	0	52.0	0	0	71.1
Ohio	-	-	-	0	0	47.9	0	0	62.4	0	0	71.5
South Dakota	-	-	-	0	0	54.8	1.7	0.4	65.3	0	0	78.5
Wisconsin	-	-	-	0	0	50.0	0	0	60.6	0	0	72.1
Region	2.8	0.2	27.9	2.0	0.3	44.9	1.0	0	56.3	0.3	0	72.1
Number of fields	36			152			200			175		

Table 6.21--Percent of total ears showing damage, percent of damaged kernels by weight, and moisture content of kernels, for ears in various stages of development--October 1, 1956

State	Stage of development														
	Mature *			Dent			Dough			Milk		
	% ears	% weight	Moisture content	% ears	% weight	Moisture content	% ears	% weight	Moisture content	% ears	% weight	Moisture content
Illinois	0	0	24.5	0	0	33.0	-	-	-	-	-	-
Indiana	0	0	31.1	0	0	44.3	0	0	51.4	-	-	-
Iowa	0	0	28.0	0	0	32.2	-	-	-	-	-	-
Kansas	0	0	11.9	-	-	-	-	-	-	-	-	-
Michigan	0	0	39.3	0	0	48.5	-	-	-	-	-	-
Minnesota	0	0	32.4	0	0	37.2	0	0	53.0	-	-	-
Missouri	0.7	0	21.2	-	-	-	-	-	-	-	-	-
Nebraska	1.4	0	26.4	0	0	39.9	-	-	-	-	-	-
Ohio	0	0	34.1	4.3	0.1	42.9	0	0	53.5	0	0	67.0
South Dakota	0	0	26.5	0	0	33.8	0	0	58.5	-	-	-
Wisconsin	0	0	35.3	0	0	44.0	0	0	57.6	0	0	67.0
Region	0.3	0	26.6	0.7	0	38.4	0	0	54.7	0	0	67.0
Number of fields	398			142			9			4		

* Includes fields mature on September 1 and harvested prior to October 1.

By the last week in October all but 97 of the sample fields had been harvested. Only in Minnesota, Wisconsin, Michigan and Ohio was there much unharvested acreage. No measurable damage was observed in any of the plots in these fields.

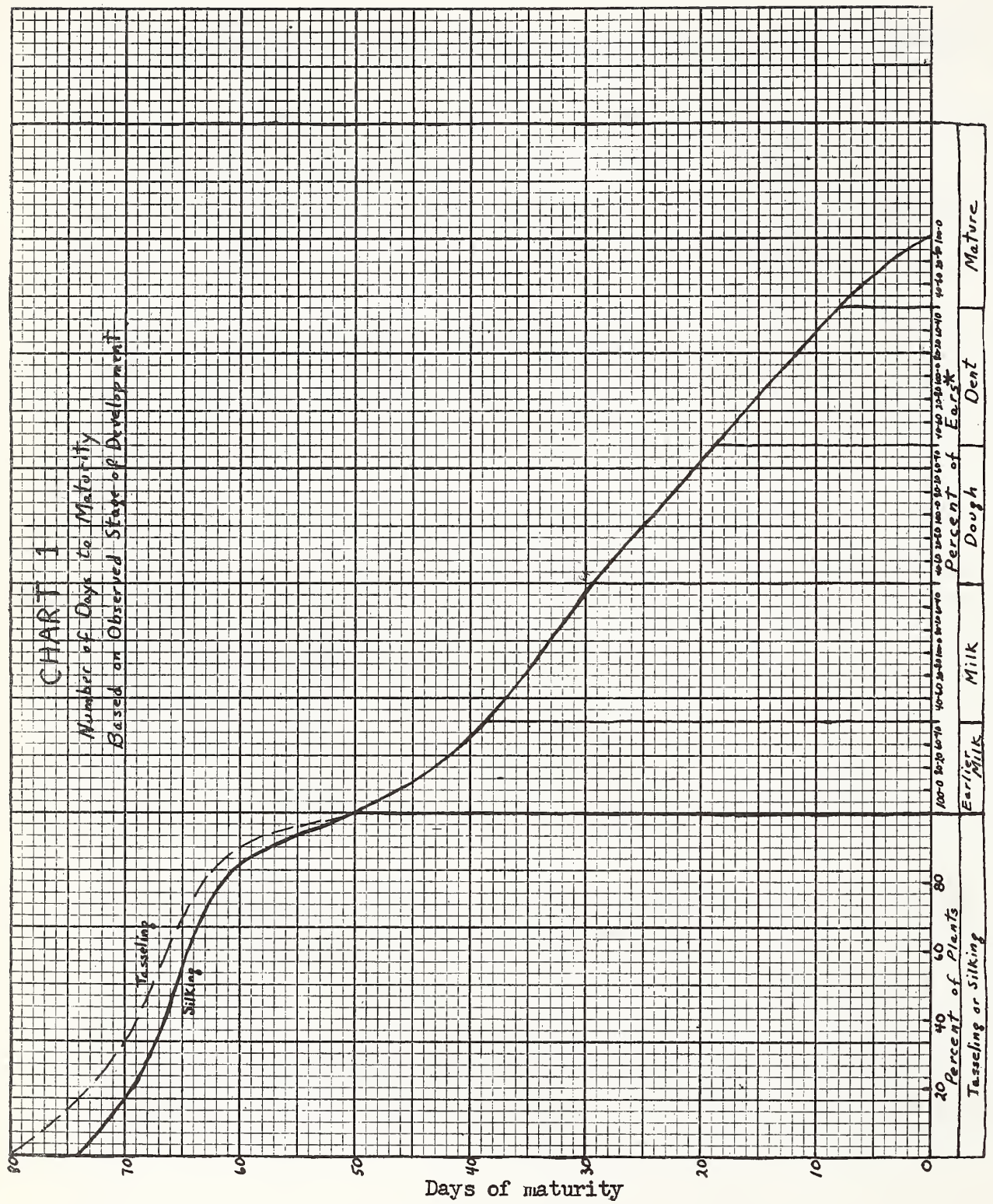
The use of objective plant observations on August 1, September 1 and October 1 to indicate the potential frost damage and to assess the quality of the grain appears to be practical and desirable. Forecasts of potential frost damage appear to be as reliable on August 1 as on September 1. The time interval between tasseling or silking and maturity is relatively constant. The September 1 Survey is useful mainly to correct for any unusual conditions which may have taken place between August 1 and September 1.

Characteristics of the grain can be observed on sample ears and damage from insects and other sources can be appraised. In 1956 very little damage was evident by harvest time. Whether this was a year in which the quality of the crop was excellent, or whether deterioration of the grain develops mainly after harvest is a moot question. If the latter is the case, it would be more important to study samples of grain in storage and going to market than to examine samples prior to harvest and at harvest time.

The percent of damaged grain by weight does not appear to be a satisfactory index of the seriousness of grain damage. Damaged kernels are usually so light that the percentage by weight is a small number even when a large number of kernels are damaged. In future studies, a new type of index will be computed that expresses the number of damaged kernels occurring in a given weight of grain. It does not seem practicable to express the number of damaged kernels as a percent of the total number of kernels because of practical difficulties in making a count of all the kernels on the sample ears. But damaged kernels can be counted quite easily and expressing that count as a percent of a given weight of grain should be just as satisfactory. It should also be possible to estimate relationships between such an index and the grain standards used by the trade. An index of the kind described here could be computed for samples of grain of different grades employed by the trade and a relationship computed between the index and those standards.

No unusual problems are involved in forecasting the date of maturity of the crop and measuring the danger from frost on August 1 and September 1. This information can be made available for release to growers and the grain trade by August 10-15 and September 10-15.

Procedures and charts, such as those given in this report, would be used in connection with field plot observations. Adequate facilities for laboratory work on sample ears must be provided if the time table for release of information to the public is to be met. These additional facilities can be provided if the service is desired.



* The larger number of each pair indicates the percent of ears in the stage of development shown below. The smaller number indicates the percent of ears in either an earlier or later stage of development depending on whether the smaller number precedes or follows the larger number.

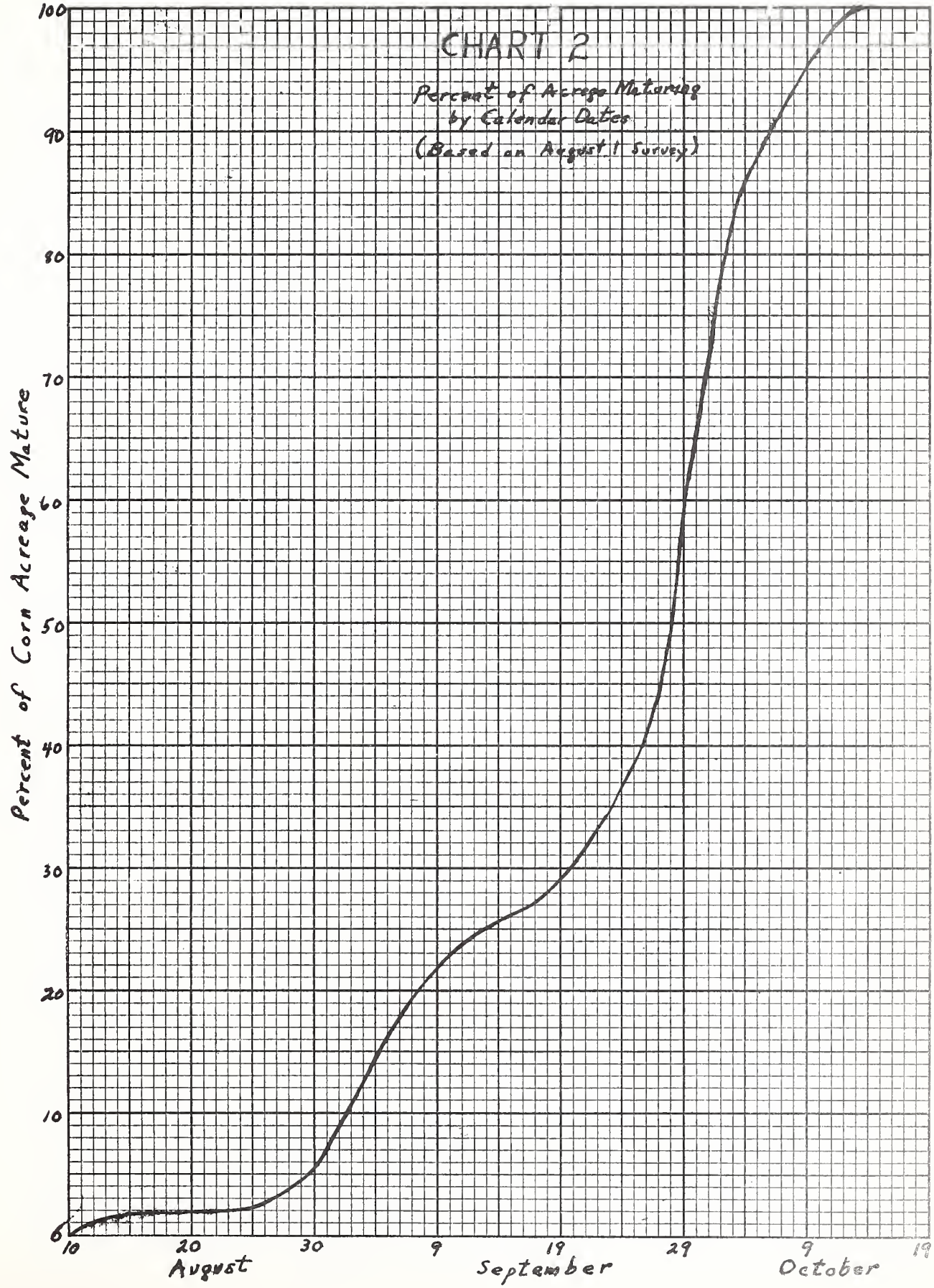


CHART 2
Percent of Acreage Maturing
by Calendar Dates
(Based on August 1 Survey)
Percent of Corn Acreage Mature
100
90
80
70
60
50
40
30
20
10
0
10
20
30
9
19
29
9
19
August
September
October

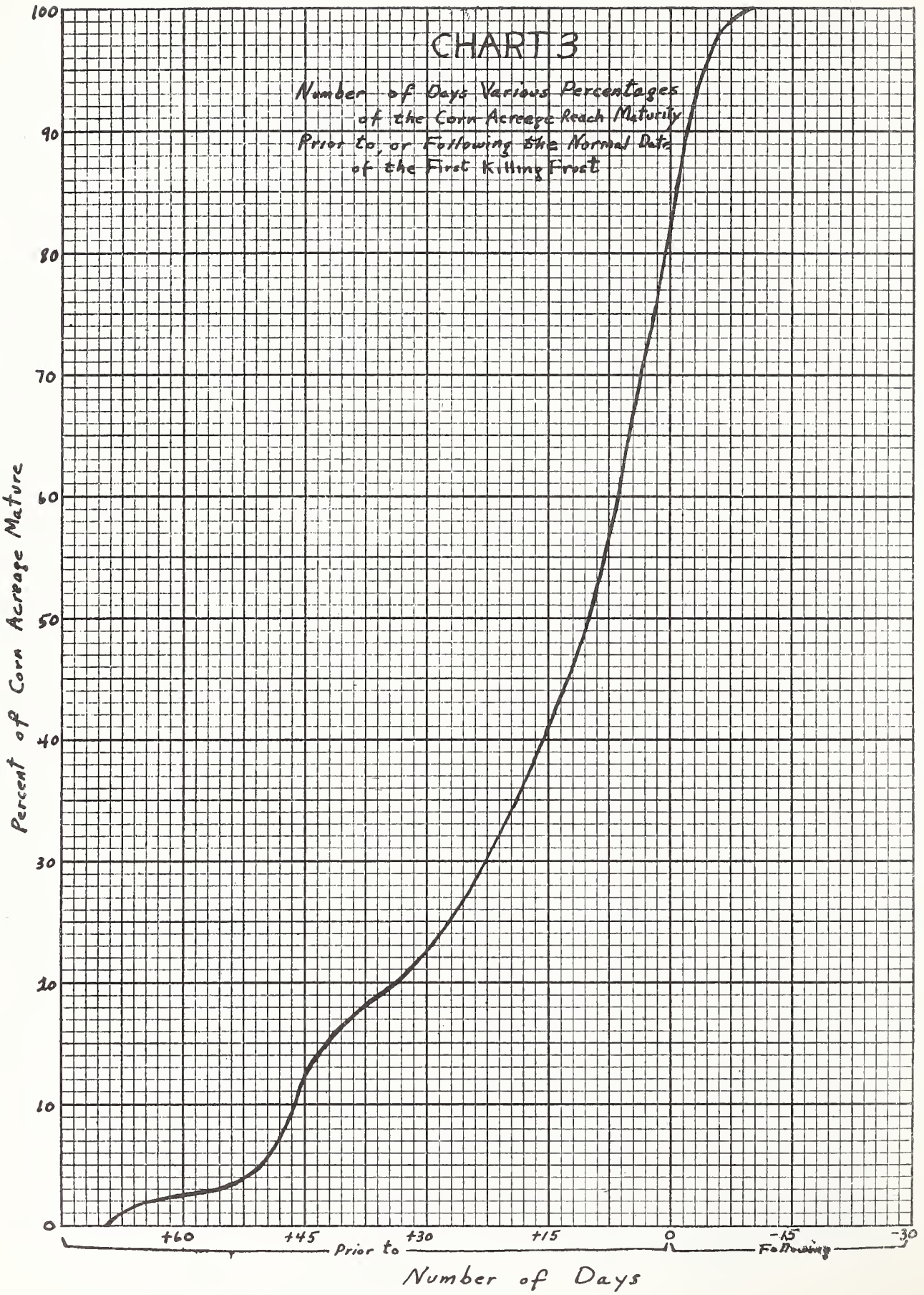


CHART 3
Number of Days Various Percentages of the Corn Acreage Reach Maturity Prior to, or Following the Normal Date of the First Killing Frost
Percent of Corn Acreage Mature
100
90
80
70
60
50
40
30
20
10
0
+60
+45
+30
+15
0
-15
-30
Prior to
Following
Number of Days

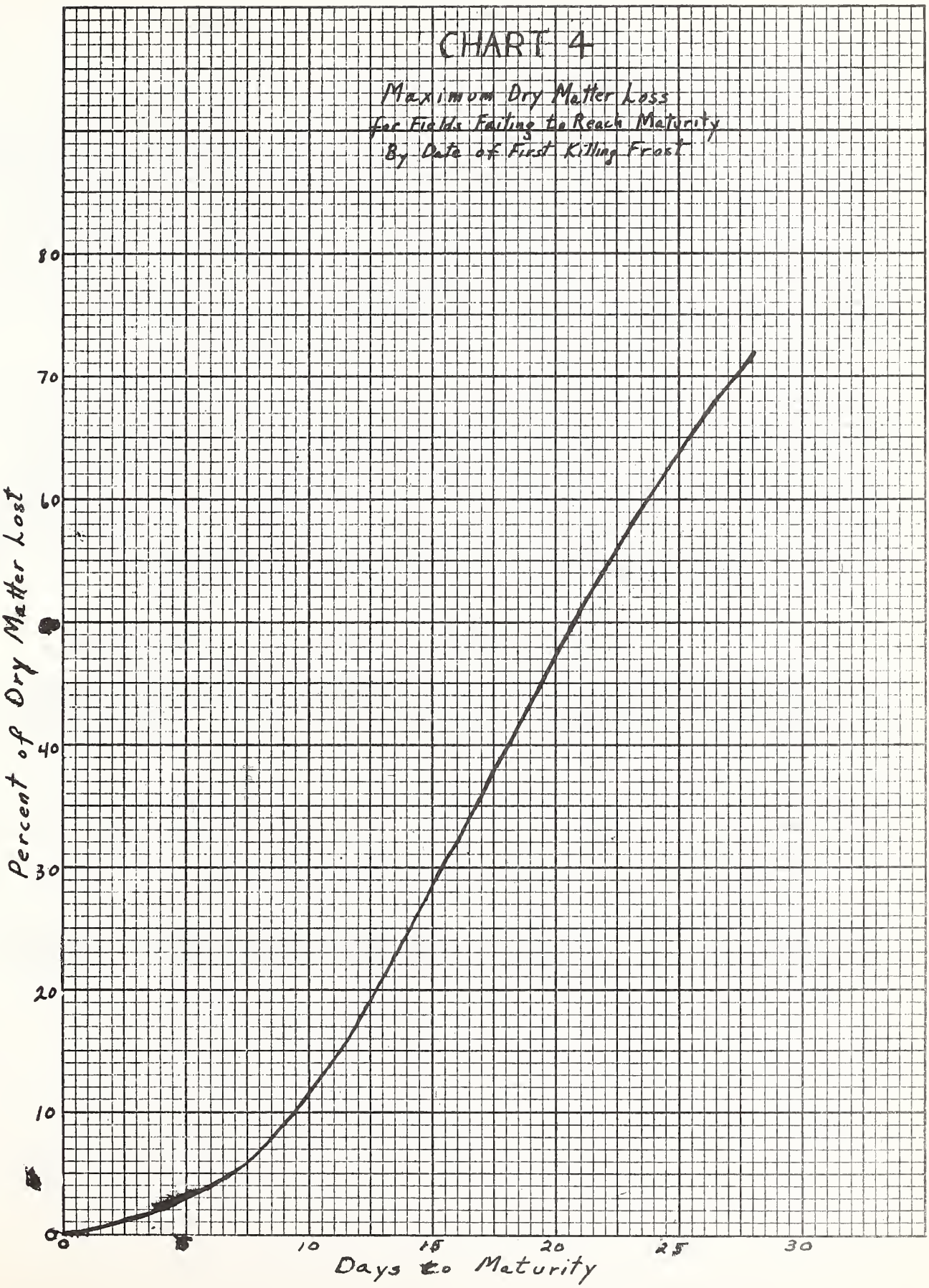


CHART 4
Maximum Dry Matter Loss
for Fields Failing to Reach Maturity
By Date of First Killing Frost
Percent of Dry Matter Lost
0
10
20
30
40
60
70
80
0
5
10
15
20
25
30
Days to Maturity

7. Objective Winter Wheat Yield Studies

7.1 Procedures and Sample Design

A subsample of wheat farms was selected from the June 1, 1955 interview survey in Texas and Oklahoma for field observations to be made in the spring of 1956. The selection of fields could not be made from closed-segment delineations on aerial photographs because the 1955 survey was not made on that basis. The subsample of farms to be used in the wheat work was allocated in proportion to the total acres for wheat reported on June 1, 1955. The sample consisted of 59 farms in the two States with 142 sampling units being allocated to these farms. Field surveys were made as of May 1, June 1, and July 1 in the 1956 growing season. Post-harvest interviews and gleanings in sample fields were also conducted, after farmers harvested the crop, as for cotton and corn.

The May 1 survey consisted of an interview with the farm operators and sample field observations for two fields for each time a sample farm was selected. As farms were selected with probabilities proportional to wheat acreages, some farms were selected more than once. The selection of sample fields on the sample farms was made by asking farmers to report the acreages in individual fields, cumulating those acreages and selecting the sample fields by the same procedure that was also used in selecting cotton and corn fields in the 1955 yield studies on cotton and corn. The allocation of farms and fields and the number of fields on which observations were actually made are shown in table 7.1.

Table 7.1--Numbers of sample wheat farms and fields

State	Selected		Field counts made 5/1	Field counts made 6/1	Field counts made 7/1	Post-harvest gleanings made
	Farms	Fields				
Okla.	35	86	86	83	0	68
Texas	24	56	40	39	8	18
Total	59	142	126	122	8	86

Although the 59 farms were selected in the two States from information reported in the June 1955 interview survey, only 52 of those farms actually had wheat standing in the fields on May 1, 1956.

7.2 May 1 Survey

On this survey, farm operators were interviewed to obtain data on wheat acreage and expected production. Acreage data reported for individual fields were also used as a basis for selecting sample fields. Although a total of 142 fields was expected, it was possible to make counts in only 126. Some farms that reported wheat in June 1955 either did not plant wheat for the 1956 season or had plowed up their plantings. Results of the May 1 interview are shown for the sample farms and the sample fields in table 7.2.

Table 7.2--Farm interview data

Item	Units
Per farm	
Acres planted - 1956 crop	214.9 acres
Acres still standing - May 1956	194.3 acres
Acres intended for grain - May 1956	185.5 acres
Yield per acre for grain	11.6 bushels
Wheat fields per farm	3.3 number
Per sample field	
Acres for grain - May 1956	91.1 acres
Yield per acre for grain	11.2 bushels

For field observations two sample plots were selected in each sample field (or each time the field was selected, if selected more than once). Each plot consisted of three adjacent drill rows 26.136 inches long. The samplers selected a set of pace numbers from a Plot Selection Sheet. A different set of pace numbers was used for each field. The location of the first plot in each field was determined from a pair of pace numbers by starting at the field corner and walking along the edge of the longer side of the field, taking the number of paces indicated by the first number, then turning at a right angle and taking the number of paces into the field indicated by the second number. Opposite the toe of the sampler's foot on the last of the required paces into the field, the sampler laid a yardstick perpendicular to, or across the first three drill rows just beyond his toe, or on his right if he was walking parallel to the rows. A U-shaped frame was slipped through the grain (i.e. stalks) so the front of the plot corresponded to the position of the yardstick. A small handful of stalks just outside the plot was tied with colored cloth at the beginning and end of rows 1 and 3 to mark the plot location for future work. The frame controlled only the length of the rows, except in the case where 3 drill rows could not be distinguished (as when seed was broadcast). In such cases the sample plot consisted of all the stalks inside the area of the U-shaped frame. For such fields the yardstick was removed after the frame was in place and laid in slots at the top, or ends of the frame arms, to serve as a "gate" to close the open side of the frame so a known area was included in the plot.

The second plot in each field was located 30 paces farther along the edge and into the field in the direction the sampler had been walking when he arrived at plot 1. Each field was classified as being on or off a road on the county highway map.

The following information was obtained for each plot.

1. Distance across 5 row spaces

2. Counts for each of the 3 rows
   a. Number of stalks or stems
   b. Number of emerged heads (spikelets visible)
   c. Number of heads in boot (no spikelets visible)
   d. Height of stalks

3. Counts for row 1 only
   a. Number of stalks showing infestation or damage

4. Stage of maturity of each plot

5. Head samples for laboratory
   a. "Ripe" or "Hard dough" stage - clip all heads in plot
   b. "Soft dough", "Milk" or "Boot" stage - clip number of heads found in row 1 from beyond unit

The results are summarized by stage of maturity in table 7.3.

Table 7.3--Average May 1 field counts per plot

Items	Stage of maturity			All stages
	Flag or Leaf	Boot or Flower	Milk	
Number of plots	115	121	16	252
Distance across 5 row spaces (feet)	3.671	3.398	3.356	3.522
Number of stalks	157.0	149.5	130.8	154.2
Number of emerged heads	0.5	78.5	129.2	46.8
Number of heads in boot	12.8	40.8	1.6	26.0
Height of stalks (inches)	10.0	16.5	22.2	13.9
Number of damaged stalks	7.5	0.9	0.3	3.9
Gross weight per head(grams)	--	0.42	0.67	0.45
Length per head (inches)	--	2.75	2.64	2.74

7.3 June 1 Survey

The same fields and plots were visited again the last week in May. The samplers proceeeded directly to the plots in the sample fields. Approximately 5 to 10 minutes were required to locate each plot, but this amount of time was not excessive and was more than offset by the time saved from not having to select a

new pair of sample plots. The use of identical plots greatly facilitated survival studies which were desired for stalks and heads as the crop approached maturity. The required observations were the same as a month earlier except for modifications in procedures for obtaining head samples caused by the more advanced stage of maturity. The data are summarized in table 7.4 according to the stage of maturity found on May 1. The plots are classified by the stage of maturity on June 1 in table 7.5.

Table 7.4--Average June 1 field counts per plot by May 1 stage of maturity

Item	Stage of maturity May 1			All stages
	Flag or Leaf	Boot or Flower	Milk	
Number of plots	113	117	10	240
Number of stalks	133.9	142.2	123.7	135.4
Number of emerged heads	110.0	134.9	122.4	120.9
Number of heads in boot	5.9	1.1	0	3.2
Height of stalks (inches)	19.9	20.8	21.8	20.4
Number of damaged stalks	2.1	1.7	0	1.8
Gross weight per head (grams)	0.74	0.68	0.74	0.73
Length per head (inches)	2.51	2.52	2.38	2.50

Table 7.5--Average June 1 Field counts per plot

Item	Stage of maturity June 1					All stages
	Boot or Flower	Milk	Soft dough	Hard dough	Ripe	
Number of plots	24	47	116	30	27	244
Number of stalks	119.2	105.3	153.9	143.1	137.3	138.0
Number of emerged heads	79.3	80.6	143.6	139.5	130.8	123.2
Number of heads in boot	9.3	8.9	1.2	0.4	0.3	3.3
Height of stalks (inches)	13.8	17.5	23.4	21.0	19.0	20.5
Number of damaged stalks	1.5	3.3	3.0	3.0	0.9	1.8
Gross weight per head (grams)	0.66	0.74	0.77	0.76	0.69	0.74
Length per head (inches)	2.51	2.59	2.47	2.56	2.48	2.50
Weight of grain per head at 14.5 percent (grams)	--	--	--	0.461	0.416	0.440
Weight of grain per foot of heads at 14.5 percent (grams)	--	--	--	2.176	1.989	2.091

Table 7.6 shows the head counts by the location of fields on and off roads on county highway maps. It was thought a random selection of fields on roads on county highway maps might very nearly represent a probability sample of all fields since public roads cover the range of agricultural variation present in most States. This has considerable bearing on proposals made from time to time on the use of route samples.

Table 7.6--Average counts per plot by location of fields

Item	Oklahoma	Texas	Two States
On roads			
Number of plots	150.	26	176
Distance across 5 row spaces (ft.)	3.5	4.3	3.6
Number of stalks	142.8	144.8	143.1
Number of emerged heads	134.8	121.5	132.8
Number of heads in boot	0.5	9.4	1.8
Number of damaged stalks	2.0	1.5	2.0
Off roads			
Number of plots	16	52	68
Distance across 5 row spaces (ft.)	3.4	3.7	3.6
Number of stalks	137.1	122.0	125.5
Number of emerged heads	124.0	90.6	98.4
Number of heads in boot	1.2	9.4	7.5
Number of damaged stalks	4.3	0.6	1.5

7.4 July 1 Survey

As most of the sample fields were harvested by mid-June, the work consisted largely of obtaining the post-harvest interview data on production and harvested acreage, and post-harvest gleanings in the sample fields. The results of the post-harvest interviews and gleanings are given in tables 7.7 and 7.8.

Table 7.7--Post-harvest farm interview data

Items	Units
Per farm	
Farmers interviewed	49 number
Acres for grain - May 1, 1956	190.0 acres
Acres for grain - Post-harvest	170.8 acres
Yield per acre	17.5 bushels
Per field	
Sample fields	122 number
Acres for grain - May 1, 1956	92.3 acres
Acres for grain - Post-harvest	75.8 acres
Yield per acre	0.6 bushels
Method growers used in determining production	
Weight of grain determined at elevator	43
Storage bin capacity	2
Bushels in combine bins	2
Number of truck loads	2

Table 7.8--Post-harvest gleaning data for pairs of plots

Item	Units
Fields gleaned	86 number
Fields plowed up	16 number
Field not yet harvested	6 number
Unthreshed or whole heads	8.4 number
Fields reporting loose kernels	85 number
Fields reporting unthreshed heads	82 number
Weight of heads, kernels, chaff, gleaned, etc.	5.98 grams
Threshed weight of grain	3.90 grams
Moisture content of grain	10.8 percent

7.5 Yield Forecasting Procedures

A May 1 forecast would involve an estimate of heads expected and some assumption about the weight of grain per head. The heads expected would be based largely on a stalk or tiller count. The total number counted on May 1 would indicate the maximum potential heads per unit or acre. However, the stalk counts are known to decrease with length of time to maturity. The data in tables 7.3 and 7.4 indicate the fraction of stalks surviving between May 1 and June 1, as well as the June 1 heads as a fraction of the May 1 stalks. These data are shown in table 7.9.

Table 7.9--Ratios of June 1 counts to pertinent base data

May 1 stage of maturity	June 1 stalks divided by May 1 stalks	June 1 heads divided by May 1 stalks	June 1 heads divided by June 1 stalks
	Percent	Percent	Percent
Flag or leaf	84.4	73.0	86.6
Boot or flower	95.1	91.0	95.7
Milk	99.8	98.7	98.9
All stages	90.1	82.6	91.6

The June 1 head count appears to represent the total number of heads to be produced, as most fields were in the milk stage or later. For fields earlier than milk on June 1, it seems likely a few more heads would be expected to form. To adjust for additional heads to be formed, the ratio of heads to stalks for fields in the milk stage or later can be used to indicate the total potential for late maturing fields. The expected head count per plot under this assumption would result in an increase of 2.2 heads per plot over the June 1 count of 126.5 or a total of 128.7 per plot. The expected heads per plot would be used with the average weight per head to indicate the weight of grain expected.

The June 1 data indicate the following yield per acre at 14.5 percent moisture:

$$\text{Gross yield per acre} = \frac{(\text{Heads in 2 Plots})\ (\text{Grams of Grain per Head})\ (\text{Sq. ft. in Acre})}{(\text{Length of row in 2 Plots})(\text{Row Spacing})(\text{Grams in Lbs.})(\text{Lbs. In Bshls.})}$$

$$= \frac{(257.4)\ (0.417)\ (43560)}{(13.1\ )\ (.70453)(453.59)\ (60)} = \frac{4,675,560}{251,180}$$

$$= 18.6 \text{ bushels}$$

Gleanings obtained in the post-harvest survey indicate the following loss per acre at 14.5 percent moisture:

$$\text{Loss per acre} = \frac{(\text{Grams of Grain in 2 Plots})(\text{Square feet in Acre})}{(\text{Length of Row in 2 Plots})\ (\text{Row Spacing})(\text{Grams in Lb.})(\text{Lbs. in Bshls.})}$$

$$= \frac{(4.06)(43560)}{(13.1)(.70453)(453.59)(60)} = \frac{176,854}{251,180} = 0.70 \text{ Bushels}$$

This loss is 3.8 percent of the gross weight per plot. The 18.6 gross bushels per acre minus the 0.7 gleanings per acre indicates a net yield of 17.9 bushels per acre.

While the objective yield of 17.9 bushels per acre is about 3 bushels above the Crop Reporting Board's final yield estimate for Texas and Oklahoma, the farmers' post-harvest yields are in fairly close agreement with the objective yield indication. The post-harvest interviews indicated that a large percent of the growers based their yields on grain weight at the elevator. The objective yield is higher than growers' reported yield, but it is within the limits of the sampling error. If a real difference exists, it may be caused by incomplete recovery of grain in gleaning.

8. Objective Soybean Yield Studies

8.1 Introduction

Objective field observations to be used in developing forecasting techniques for soybeans were started on a sample of 155 fields in the North Central States during the 1956 growing season. Soybean fields were selected in the important producing areas from information reported in the June 1956 interview survey as for cotton and corn. Field observations were made as of August 1, September 1 and October 1 together with a post-harvest survey as for other crops.

Only about one-half of the fields were visited on the August 1 survey because so little was known about the behavior of the soybean plant that it did not seem desirable to make the first counts on a larger sample. More frequent observations on the growth habit of the soybean plant were made on a small number of fields close to the Illinois office of the Division specifically for the purpose of observing the fruiting habit of the plant and to develop working hypotheses that could be incorporated into a forecasting model that could be tried out on the more extensive observations made over the entire producing region. In these intensive studies three plants were observed at frequent intervals throughout the entire growing season in each of 12 fields. It was believed that the soybean plant would behave in a manner somewhat similar to the cotton plant so that an adaptation of the procedures that seemed to be successful for cotton could be applied to forecasting soybean yields.

In developing a technique for forecasting yield, it is convenient to consider the individual components of yield and to study the behavior of each component separately. Soybean yields are measured in pounds per acre, individual components being the number of plants per acre, the number of pods per plant and the weight of beans per pod. Studies on the 1956 data were limited to studying the problem of forecasting the number of pods produced.

As of August 1, it is necessary to forecast the number of pods that will be present on the average plant at harvest time. Pods are still being formed on August 1, so that the plant does then not yet have its full load. In any fairly broad region, individual fields are also in different stages of maturity as of August 1 because of variations in planting dates, differences in growing conditions, and varietal differences, so that on a particular date the plants are carrying different fractions of the full load.

The intensive Illinois data were used to develop relationships between observable plant characteristics that reflect the stage of maturity of the plant so that the fraction of a full load represented by the pods already present by any specified date could be estimated from those maturity observations.

8.2 Analysis of Illinois Data

Frequent observations were made on numbers of blooms, brown blooms, and pods on the individual plants selected. These counts were identified by field, date, plant number and by position on the plant with respect to nodes and laterals. These detailed counts provided an excellent picture of the fruiting behavior of

soybean plants and led to a working hypothesis that was later applied successfully to the extensive surveys made at monthly intervals in the North Central States.

The plants in this study seemed to reach their maximum pod load as of about August 5. Using that date as a reference date, the fruiting curves for all plants were shifted so that the maximum load for each individual plant would correspond to that date. This merely put the fruiting curves for all plants on a biological age basis rather than a chronological age basis. After this adjustment, the average percent of maximum pod load for the period June 28-September 11 becomes as shown in table 8.1.

Table 8.1--Average percent of maximum pod load, Illinois soybean data

"Date" of count	Average percent of maximum pod load
	Percent
June 28	0
July 11	6.2
July 17	20.2
July 28	81.0
August 5	100.0
August 28	87.5
September 11	77.1

The rate at which the plant reaches its maximum load from the time pods first begin to appear follows the pattern of most growth curves. After the maximum load has been attained, there is a progressive decrease in number of pods from week to week that can be represented fairly well by a linear relationship. In summary, examination of all the Illinois data shows that about two weeks after the plant starts to bloom it is carrying its maximum number of blooms; it is at this time that pods begin to set. About two weeks later, the numbers of blooms and pods on the plant are approximately equal and the older pods have already reached their full length. In one more week, the plant has its maximum fruit load, in terms of blooms and pods combined, and bean formation in the older pods has progressed to the point where the presence of beans can be detected in some of the pods. One week later, or about four weeeks after pods have begun to set, the plant is carrying its maximum number of pods. About three weeks after the maximum pod load has been reached, the plant has stopped blooming and has also shed about 13 percent of its pods. An additional 16 percent of the pods are lost between the time blooms are no longer seen on the plant and the time at which plants reach maturity. This leaves about 71 percent of the maximum number of pods produced by the average plant available for harvest.

An attempt is being made to identify recognizable maturity stages in the fruiting plant that can be associated with the percent of maximum pod load represented by the pods already present at each such maturity stage. The maturity characteristics that were chosen and the percent of maximum pod load represented by the pods present at that stage are shown in table 8.2.

Table 8.2--Percent of maximum pod load of soybean plants by maturity classes

Maturity class	Percent of maximum pod load
	Percent
Pods have not begun to set	0
More blooms than pods on plant	15
More pods than blooms on plant	75
Plant carrying both blooms and pods with beans	100

These observations suggested that an August 1 forecast of maximum pod load could be computed for a region by classifying plants in the sample fields into these maturity classes and expanding the pod count in each maturity class to a 100 percent level according to table 8.2. That procedure is similar to one that has worked fairly well for cotton. The procedure was tested by applying it to the data collected over the entire soybean-producing area of the 11 North Central States.

8.3 August 1 Survey

In this survey, one-half of the total sample of 155 fields in the North Central States was visited for plant observations. Interviews were also conducted with growers as for other crops. Two sampling units, each consisting of a 3-foot double row section, were selected in each field and marked clearly so that the same plots could be used on later visits. All plants were counted on both row sections in the units, but pods were counted on only one of the two row sections at each location. Detailed counts of blooms, pods, nodes, and laterals were made on one plant adjacent to each row section in which pods were counted. These were used to estimate the maturity classification of the field. The maturity observations were used to classify fields into the 4 maturity classes shown in table 8.3.

Table 8.3--Classification of sample fields by State and maturity class

Maturity class	Number of fields									Regional total	
	Ill.	Ind.	Iowa	Kan.	Mich.	Minn.	Mo.	Nebr.	Ohio	S.D.	
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	Pct.
Pods not set	1	3					2		2		8	11
More blooms than pods	2	3	2		1	2	3		3	1	17	24
More pods than blooms	14		1	2		2	1	3	1	2	26	37
Some pods with beans	3	3	4			6	3		1		20	28
Total by States	20	9	7	2	1	10	9	3	7	3	71	100

Percent of maximum pod load represented by the pod count in each class of field and the computation of the average percent of full load for the region as a whole are shown in table 8.4.

Table 8.4--Computation of average percent of full load

Maturity class	Relative number of fields	Percent full load
	Percent	Percent
No pods set	11	0
More blooms than pods	24	15
More pods than blooms	37	75
Some pods with beans	28	100
Weighted average	100	59.4

The computations in table 8.4 show that the average number of pods per plant for the region as a whole as of August 1 represented only 59.4 percent of the total number of pods that would be formed. The average number of pods counted on the 2 row sections in each sample field was 798 as of August 1. Dividing that count by 0.594 gives a forecast full load of 1,343 pods per double row section.

Using the relationships that were derived from the intensive Illinois observations, the numbers of pods expected to be found as of September 1 and October 1 were computed. It was assumed that 87 percent of the maximum pod load forecast as of August 1 would still be present on September 1. It was also assumed that 71 percent of the maximum pod load would be present on October 1. Applying these percentages to the forecast maximum load of 1,343 pods, gives an estimate of 1,168 pods expected to be present on September 1 and 954 as of October 1. Counts actually made as of September 1 and October 1 showed 1,198 to be present on September 1 and 946 on October 1. The August 1 pod forecast thus agreed closely with the subsequent behavior of the plants.

8.4 September 1 and October 1 Surveys

The same sample plots that were visited as of August 1 were visited again as of September 1. In addition, observations were made on the remainder of the entire 155-field sample. All of the sampling units in the 155 fields were also visited again as of October 1.

By September 1 most plants usually have stopped blooming and beans are developing in most of the pods. The forecasting problem at this time is essentially one of forecasting pod losses between September 1 and harvest. Examination of the September 1 and October 1 data showed that the ratio of pods with beans to the total number of pods present as of September 1 was almost identical to the ratio of the October 1 pod count to the September 1 pod count. This suggests that the

relative number of pods with beans present on September 1 is a good indication of the total number of pods that will be found on the plants one month later. The relationship seems to imply that plants mature enough to stop blooming are carrying the pods that will still be present at harvest time in the form of pods with beans and that any pods not yet containing beans tend to be shed by the plant. These observations apply to plants that have stopped blooming by September 1. For plants that are still blooming, the relationship may not hold. The type of relationship just described is illustrated in table 8.5 for the State of Iowa where September 1 and October 1 data were tabulated by individual fields.

Table 8.5--Pods on identical row sections, September 1 and October 1, compared with pods and pods with beans on a single plant in the same field on September 1 (Iowa)

Sample field number	Pods per row section			September 1 pod classification for individual plant		
	Sept. 1	Oct. 1	Oct./Sept. ratio	Total pods	Pods with beans	Relative number with beans
	Number	Number	Percent	Number	Number	Percent
63	614	376	61	70	52	74
64	623	615	99	68	68	100
67	1696	1554	92	37	35	95
68	1492	1224	82	35	35	100
70	732	655	89	33	28	85
74	650	650	100	69	69	100
76	1550	1428	92	57	50	88
78	976	927	95	44	27	61
79	1289	1362	106	85	71	84
80	794	794	100	41	35	85
81	1323	1210	91	124	124	100
83	865	520	60	16	13	81
84	497	361	73	19	15	79
Total	13,106	11,676	89	698	622	89

The State and regional summary is shown in table 8.6.

Table 8.6--Pods per row section, September 1 and October 1, compared with September 1 ratio of pods with beans to total pods

State	Pods per row section			September 1 pod classification for individual plant		
	Sept. 1	Oct. 1	Oct./Sept. ratio	Total pods	Pods with beans	Relative number with beans
	Number	Number	Percent	Number	Number	Percent
Iowa	997	898	90	1089	981	90
Ill.	1223	966	79	2321	2117	91
Kan.	1240	732	59	515	306	59
Mich.	1429	1091	76	326	271	83
Minn.	1465	1142	78	1312	965	74
Mo.	1272	1012	80	1650	1319	80
Nebr.	1497	196	13	250	97	39
Ohio	1009	823	82	1050	749	71
Ind.	1171	792	68	1293	1128	87
S. D.	1066	767	72	190	94	49
Wis.	657	736	112	190	130	68
Region	1198	946	79.0	10,086	8157	80.9

The averages for Iowa are slightly different in this table than in table 8.5 because exactly the same sampling units were not covered in the two computations.

At the time of the September 1 yield forecasts, the ratio of pods with beans to total pods was 80.9 percent. Applying that ratio to the September 1 pod count of 1,198 per row section provides a forecast of 969 pods to be expected as of October 1 as compared to the 946 actually counted on October 1. The forecast of the October 1 pod count by this method also agrees quite closely with the forecast obtained previously from the average percentage pod loss observed in the intensive Illinois data.

In addition to the September 1 and October 1 pod counts, post-harvest interviews and post-harvest field observations in harvested fields were conducted as for other crops.

The information obtained by these surveys is summarized in tables 8.7 and 8.8.

In the laboratory, counts were made of the number of pods that were completely stripped from row sections during the October 1 survey. These counts averaged 1,062 pods per row section. When compared with the average of 946 counted on the plants, an under counting of about 11 percent is indicated. The laboratory analysis of these samples showed that the average pod weighed 0.2779 grams and the average pod with beans weighed 0.2924 grams. Average moisture content was 6 percent.

Using 1062 pods per row section, an average weight per pod of 0.2779 grams and an average row width of 3.107 feet, gross yield was computed at 25.3 bushels per acre. Similarly, harvesting loss was computed to be 1.8 bushels per acre. The objective estimate of net yield thus was 23.5 bushels per acre.

Table 8.7--Post-harvest interview, soybeans

State	Sample field	Ratio of acres for harvest to acres standing June 1	Reported yield per acre	Reported harvesting loss per acre
	Number	Percent	Bushels	Bushels
Illinois	42	100.0	28.4	1.4
Indiana	20	99.1	26.1	1.4
Iowa	22	98.3	19.2	1.3
Kansas	6	94.0	17.0	1.7
Michigan	6	99.0	29.1	1.6
Minnesota	21	100.0	21.2	1.4
Missouri	21	97.1	22.6	1.8
Nebraska	6	104.8	6.2	1.1
Ohio	16	95.1	24.8	2.0
South Dakota	5	100.1	1.4	2.3
Wisconsin	5	103.3	10.7	0.7
Region	170	98.9	22.9	1.5

Table 8.8--Post-harvest observations for 12 feet of row

State	Plants	Pods on plants	Pods on ground	Whole beans	Split beans
	Number	Number	Number	Number	Number
Illinois	90.8	13.4	27.0	122.5	9.9
Indiana	91.0	30.3	47.8	257.7	18.0
Iowa	100.6	29.0	61.5	259.5	17.0
Kansas	72.3	6.7	84.3	188.0	4.3
Michigan	4.0	15.5	24.0	151.0	13.0
Minnesota	126.8	14.9	34.2	140.2	5.7
Missouri	71.8	36.1	47.7	218.4	12.6
Nebraska	100.2	22.8	62.7	166.8	9.8
Ohio	68.7	38.2	25.4	172.9	7.7
South Dakota	122.2	64.6	70.8	162.6	2.4
Wisconsin	98.5	28.0	13.5	105.0	1.3
Region	89.9	24.8	39.8	180.4	10.8

Studies on procedures for forecasting pod numbers are still underway. Alternative maturity classes to be used for forecasting additional pods to be formed as of August 1 need to be considered. For September 1 forecasts, some more detailed studies need to be made on plants that are still setting pods as of that date. For States where plants tend to mature late in the season, it may be advisable to investigate alternative devices for projecting fruit counts to a maturity stage corresponding to the end of blooming. The other components of yield also still remain to be investigated. Estimates of the number of plants per acre can be derived easily from the plant counts in the measured row sections. The weights of beans also need to be brought into the picture. Mature beans were picked from the sample fields and sent to a central laboratory at the Illinois office for threshing, weighing, and moisture determinations. However, those data have not yet been studied in detail.

9. Cooperative Studies at Iowa and North Carolina Statistical Laboratories

9.1 Studies at Iowa State College

The studies on forecasting and estimating corn yields by objective methods were continued during the 1956 season. Detailed observations on plant development, ear formation and yields were obtained on an extensive sample of corn fields in central Iowa. Relationships on ear development were applied to forecast corn yields from extensive field observations throughout the North Central States on an experimental basis.

One important phase of the study was to compare actual weights of corn harvested from the sample fields by farmers with preharvest yield estimates derived from small measured row sections. This study was undertaken to shed additional light upon large differences that had been obtained from small preharvest samples and yields reported by farmers. Although it was believed that most of the differences could be ascribed to under-reporting of yields by farmers, it seemed desirable to test the possibility of a bias in the results from small samples.

These studies were conducted on 7 farms where farmers had expressed a willingness to cooperate and where facilities for weighing large quantities of corn were available. The total amounts of corn harvested from these sample fields agreed with the production computed from small preharvest samples within about 2.5 percent, when all factors such as unplanted areas of the field and harvesting losses were introduced into the computations. Thus, there was no evidence of any consistent bias in the results from the small preharvest samples. However, for individual fields the discrepancies were larger than would be expected from the size of the sampling error involved. It appears that some field workers consistently obtained preharvest data that were too high while others consistently obtained data that was too low. Such personal differences appeared to average out but they seem to be worthy of additional study. These studies will be continued in 1957 and attempts made to determine at what stage in the sampling operation such biases are most apt to appear.

In addition to these research studies, the Statistical Laboratory also served as the processing laboratory for moisture determinations and other laboratory observations on sample ears collected in the extensive yield and quality studies conducted over the 11 North Central States.

9.2 Studies at North Carolina State College

In 1956 studies were started on objective yield forecasting procedures for peanuts. Observations were made on 40 sample fields in Northampton County at monthly intervals from August 1 to harvest time. Counts of pegs and pods were made on sample plants through the season, and the total weight of peanuts harvested at the end of the season was ascertained from the growers.

It was difficult to relate counts of pods on the plants to final production because of harvesting losses that occur during farmers' digging, stacking, and threshing operations. Losses that occurred while peanuts were going through the curing stage in the stacks were particularly troublesome because it is impractical to count peanuts in stacks of the size used by farmers. These studies are being continued in 1957 with the principal modification being made in the method of estimating losses occurring in stacks. Stacks of various sizes, smaller than those used by farmers, will be studied to learn the relationship that exists between percentage loss and size of stack. That relationship will be used to estimate losses in stacks of the size used by farmers.

The Laboratory also conducted studies in sample survey procedures. A sample farm survey was carried out in Northampton County by the area sampling method in which the measures of "size" assigned to the sampling units were assigned by two different methods. The first measure of size was that used in the Master Sample materials. The second measure of size was a revision based upon more recent information available to statisticians of the College, The results were inconclusive in that the over-all sampling errors obtained by applying the two measures of size were not appreciably different. However, there were some indications that the new measures of size might be superior if the experiment had been conducted on a larger scale.

10. Operations and Costs

10.1 General Operations

The Research Program operations entered into a new phase in 1956. "Closed segments" were used to collect data on the acreages in various crops and land use, livestock and poultry numbers within the segment boundaries, and farm operators living inside the segment boundaries. "Open segment" procedures were also applied to the same segments to study livestock and poultry numbers by two methods. Since this was the first year that the Research Program used the closed segment approach for the June survey, costs and operational details were watched very closely. In the 1956 program, 11 North Central States were added as a new separate region of study and Virginia and Kentucky were added to the former 10 Southern States.

The sample segments for the June survey fell in 548 counties in the 23 States. All together, 1,106 segments were enumerated by 169 interviewers under the supervision of 26 State Supervisors and 15 supervisory enumerators. An acreage verification survey was made in 367 "operator tracts" in August. Acres harvested and crop production, livestock and poultry inventories and production were obtained as of October 1 and December 1 by enumerating 996 and 1992 tracts, respectively. The Objective Yield Program was stepped up to include 1,004 cotton fields, 1,360 corn fields, 170 soybean fields, and 142 winter wheat fields.

10.2 June Acreage and Livestock Survey

The June survey questionnaire was designed to allow all data for a complete segment to be recorded in columnar form on a single schedule. In 1955 a separate schedule was used for each farm. This change made for ease of tabulation and selection of fields for objective observations. The number of pieces of paper handled by the enumerator was reduced, but the listing of several farms on the same schedule can sometimes cause the enumerator to become confused. The questionnaire was divided into six sections as follows:

I. Tract Identification Section
II. Fields and Crops in Segment
III. Livestock and Poultry Located in Segment
IV. Stocks of Corn and Wheat in Segment
V. Entire Farm: Tenure, Crops and Pasture
VI. Entire Farm: Livestock and Poultry

Section I was used to list the name of the farm operator, or the person in charge, of each tract of land inside the segment boundaries. Name, address, and whether the person lives within the segment were listed.

Section II was set up in tabular form so individual-field data could be added and summarized on the schedule for each segment. Separate columns were provided for major crops. Identification numbers for tracts and fields were recorded at the side of the page, giving each field a separate line, in much the same manner

as a regular office listing sheet. This system has the advantage of ease of summarization because all crop data for an entire segment are in one place. However, some enumerators had difficulty in following the field line across the page to the proper column. Because of the difference in crops grown in the North Central and Southern States, two regional schedules were designed. The Southern schedule included such crops as cotton, peanuts, and tobacco, which were excluded for the North Central States.

Section III was also designed for ease of summarization in a tabular form. Questions were listed at the tops of columns, with spaces for each tract on a separate line underneath. Cattle inventories, calf crop, and milk production data were secured. Pig and hog inventories, pig farrowings during the past six months and pig farrowings expected in the following six months, along with some inventory information on sheep and chickens, were obtained. All data in Section III were restricted to livestock and poultry within the segment boundary at the time of the interview. This presented little difficulty to the enumerator because in most cases the farm operator could tell which of his "fields" in the segment contained livestock and poultry. Most operators could tell where calves were born or where pigs had been farrowed.

Section IV, on stocks of corn and wheat, asked for farm-stored stocks of these two grains located within the segment boundaries. These were recorded in a tabular form so segment totals could be computed easily. No difficulty was encountered in recording data in this section or in getting the answers to the questions from respondents.

Sections V and VI were asked only of farm operators who lived inside the segment boundaries. In Section I the farm operator or the person in charge of the tract was recorded and a "yes" or "no" answer was obtained to the question whether he lived inside or outside the segment boundaries. If a "yes" answer was recorded in Section I, the questions in Sections V and VI were asked. The first part of Section V covered questions about acres of land owned, managed, or rented, to obtain total land operated by each respondent. These questions were followed by a series of questions to determine whether any agricultural products were being produced on that land, so that the operation could be correctly classified as farm or non-farm.

Section VI repeated the livestock and poultry questions used in the closed-segment reports of Section III, but this time the questions applied to the entire farm as defined in Section V. This is not the best interviewing technique, since the respondents cannot understand the reason for asking this same question two times. If all land in the farm was within the segment boundaries, Section VI was not asked of the respondent, but the enumerator was instructed to copy the figures for the various questions in Section III over to Section VI. In many cases, this was not done by the interviewers, but had to be done by the editors when the questionnaires were reviewed.

While the questions in the first four sections were being asked, care was required to make sure that the respondent knew what land was within the segment boundaries. The enumerator repeatedly referred to the aerial photograph during the interviews. Supervisors and editors checked data reported on the questionnaires against what was seen on the aerial photographs for completeness and general accuracy of reported figures.

10.3 Training of Supervisors and Interviewers

Three-day training schools for State Supervisors and newly-appointed supervisory enumerators were held in Jackson, Mississippi, and Springfield, Illinois. Seventeen men from the State offices attended the Jackson school with Georgia, Kentucky, Virginia, Texas, and Mississippi each being represented by two men. At the Springfield school, 20 State representatives were present including two men each from Illinois, Indiana, Iowa, Kansas, Michigan, Ohio, and Wisconsin. South Dakota sent three student trainees who acted both as supervisors and enumerators in the field work. Each of the schools was attended by seven men from the Washington office, including men from the Commodity Branches and the Director's Office. Training was divided into two days in the classroom and one day in the field, enumerating practice segments.

Interviewer training schools were held in each State for a two and a half day period. One school was held in a central location in each State, except for Texas and South Dakota. In Texas two schools were held because of the large number of interviewers and the distance to any one central location. For South Dakota the interviewers were trained at the regional school. The desired training program was again set up in a formal manual to provide a systematic and orderly approach and to insure that all enumerators in each region would get about the same training.

The first day was spent on general information, the purpose of the survey, and a discussion of the questionnaire and how it was to be used with the aerial photographs. The second day was spent on practice enumeration in the field. A half-day session on the third day was spent on review, special problems, handing out materials, and making assignments. These assignments consisted of setting a time when the State Supervisor or his assistant would visit each enumerator. This meeting with the interviewer, after he had completed one or two days' work, or at least one segment, was considered a continuation of the training program. Supervisors were able to correct many errors which would have been repeated if the visit had not been made.

10.4 Interviewers

Interviewers were hired by State Statisticians at the approximate rate of one interviewer for each eight segments to be enumerated. They were paid at the rate of $1.53 per hour and $0.07 a mile for official auto travel. During the training session, they received $10.00 per diem for expenses. Two and one-half days salary was paid to each enumerator for the training period. When enumerators were required to stay away from home overnight during the actual survey they received $9.00 per diem.

The manual, Instructions for the Employment of Enumerators, which had been prepared earlier for the Research Program and for the Expenditure Survey, was used in the hiring of enumerators. This was the first year in which a consolidated set of administrative instructions was available to State Supervisors for this purpose.

10.5 Field and Washington Editing

Editing in the field was held to a minimum by having the State Supervisors determine only the completeness of the schedule. If the questionnaire was incomplete enough to warrant returning it to the enumerator, the Supervisor was instructed to do so. In some cases the State Supervisor contacted the enumerator and, in the course of his regular field travel, obtained answers for missing questions. When the schedules were determined to be relatively complete, they were sent to the Washington office for final editing and summarization.

When the questionnaires were received in Washington they were checked in and edited by the Washington staff, including commodity specialists. Missing data were edited in on the basis of similar reports or averages for other tracts or farms in the segment or county. One of the main editing problems was the determination of whether a place was a farm or not. Again, the Census Bureau point system was used and an operator living in a segment classified as being a farmer or not. In Sections V and VI where data for entire farms were listed, places were classified as farm or non-farm.

10.6 Time Required for Enumeration

The interviewing time was planned to extend over approximately two weeks, beginning June 4. A few States began a day early to facilitate training of enumerators. Table 10.1 gives the daily cumulative percentage completeness from June 4 to June 15. It will be noted from the rate of completion for the two regions that work proceeded at approximately the same rate in both areas. Many enumerators completed their assignments early in the second week.

Table 10.1--Segments Enumerated by Specified Date

Date	South	North Central
	Percent	Percent
June 4, Monday	15	14
" 5, Tuesday	25	23
" 6, Wednesday	35	37
" 7, Thursday	43	49
" 8, Friday	53	60
" 9, Saturday	57	65
" 10, Sunday	57	65
" 11, Monday	67	74
" 12, Tuesday	80	83
" 13, Wednesday	88	90
" 14, Thursday	94	95
" 15, Friday	97	98

In any survey, there is always considerable interest in the average time required to enumerate a segment. Table 10.2 shows the average "hours spent in the segment" to be a little over 8 hours in the Southern States and slightly under 7 hours in the Northern States. This was derived by taking the difference between time work began and time work ended, as recorded on the questionnaire by the enumerator. The column entitled "Total Hours" is the total time for which enumerators, assistant supervisors, and State Supervisors were paid during the survey proper. This includes time for driving to and from the segment, checking over the work, sending material to the State office, and supervisory meetings between the supervisors and enumerators. The data indicate that about 5 hours per segment were spent in travel and supervision in the Southern States, and a little over 4 hours in the Northern States. There was considerable variation between States.

Table 10.2--Average Enumeration Time per Segment

State and Region	Total time worked			Time spent in segment
	Interviewers	Supervisors	Total	
	Hours	Hours	Hours	Hours
Alabama	9.3	2.0	11.3	7.6
Arkansas	10.1	1.7	11.8	6.9
Georgia	9.8	1.2	11.0	6.8
Kentucky	10.4	2.9	13.3	7.3
Louisiana	11.1	.9	12.0	7.2
Mississippi	12.4	3.4	15.8	8.8
North Carolina	14.2	1.5	16.7	10.2
Oklahoma	11.7	1.4	13.1	7.6
South Carolina	7.9	2.9	10.8	7.6
Tennessee	11.3	3.5	14.8	8.9
Texas	11.2	2.5	13.7	8.1
Virginia	11.0	1.6	12.6	8.9
South	11.0	2.3	13.3	8.1
Illinois	12.7	4.6	17.3	9.2
Indiana	7.1	.8	7.9	4.9
Iowa	10.9	2.8	13.7	6.3
Kansas	8.7	2.3	11.0	7.0
Michigan	8.3	.3	9.6	7.6
Minnesota	8.4	.8	9.2	5.1
Missouri	9.6	1.0	10.6	6.9
Nebraska	5.6	3.4	9.0	6.9
Ohio	9.0	1.1	10.1	6.6
South Dakota	6.5	3.7	10.2	8.4
Wisconsin	11.0	2.5	13.5	8.4
North Central	9.2	2.1	11.3	7.0
South and North Central	10.2	2.2	12.4	7.6

10.7 State Expense of Operating the June Survey

The expenses of operating the June 1956 Research Survey are shown in the following two tables which were prepared from the "Summary of Survey Field Costs" submitted by the State offices. Table 10.3 shows the average cost per person for training supervisors and for hiring and training enumerators. The number of persons used to calculate these averages is given in the first two columns.

"Out of pocket" expenses are funds which States expended because this particular survey was made. The difference between the "Total" and "Out of pocket" expenses represents salary costs of regular office staff. This is covered by the allocation of additional salary funds to the State offices.

Table 10.4 gives the average cost per segment. This is the most important cost figure from the standpoint of estimating costs and allocating funds for future surveys. Those expenses occurring from the time the enumerator finished his formal training until his field assignment was completed are included in "Survey proper". This also includes travel expenses of the State Supervisor and the salary and travel expenses of the supervisory enumerator during the enumeration phase of the survey.

The "Totals" under "Average cost per segment" columns include all expenses of the survey, both out-of-pocket and regular salary costs, including the hiring and training of supervisors and interviewers and all office work required.

Table 10.3--June 1956 Research Costs per Person

State and Region	Supervisors trained	Enumerators	Average cost per person					
			Supervisor training		Hiring enumerators		Enumerator training	
			Out of pocket	Total	Out of pocket	Total	Out of pocket	Total
	Number	Number	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Alabama	1	9	65.23	116.75	9.92	23.71	70.57	76.04
Arkansas	1	7	65.08	173.24	5.01	25.96	93.01	126.75
Georgia	2	8	98.44	156.76	5.24	8.55	90.72	107.31
Kentucky	2	8	112.76	177.22	12.41	30.94	77.27	92.64
Louisiana	1	5	54.00	143.08	16.17	42.83	74.18	102.38
Mississippi	2	8	--	142.00	2.71	16.96	81.12	95.12
North Carolina	1	9	152.90	255.94	10.13	46.42	84.80	106.52
Oklahoma	1	7	122.37	220.61	7.18	21.54	70.98	82.05
South Carolina	1	6	125.90	212.90	8.84	29.97	51.35	71.58
Tennessee	1	8	86.41	159.52	4.98	28.77	86.12	102.44
Texas	2	15	85.00	189.00	18.93	54.33	85.80	113.60
Virginia	2	8	177.14	232.96	.69	45.02	77.38	103.49
South	17	98	95.21	181.06	9.10	32.80	79.72	99.57
Illinois	2	8	27.52	57.52	11.64	38.95	77.74	83.99
Indiana	2	6	78.32	128.24	41.42	42.73	73.82	87.68
Iowa	2	10	83.70	109.86	9.18	16.94	73.77	82.00
Kansas	2	6	111.50	148.50	5.17	21.17	81.83	90.67
Michigan	2	6	100.55	138.54	53.65	71.92	79.18	88.23
Minnesota	1	6	116.35	188.03	15.77	37.98	75.63	138.52
Missouri	1	9	54.50	144.26	.49	42.20	55.09	80.44
Nebraska	1	4	113.05	177.37	13.55	34.99	78.36	137.22
Ohio	2	7	130.52	161.96	62.63	117.40	68.38	74.37
South Dakota	1	3	--	--	--	--	162.00	162.00
Wisconsin	2	6	59.57	170.93	27.16	67.60	66.34	105.73
North Central	18	71	81.51	130.04	21.70	46.07	75.98	96.29
South and North Central	35	169	88.17	154.82	14.40	38.38	78.15	98.19

Table 10.4--June 1956 Research Costs per Segment

State and Region	Segments	Average cost per segment					
		Survey proper		Editing		Total	
		Out of pocket	Total	Out of pocket	Total	Out of pocket	Total
	Number	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Alabama	56	26.98	29.37	--	1.32	41.08	48.80
Arkansas	47	32.39	35.47	1.61	2.83	49.98	64.73
Georgia	51	30.38	32.62	1.50	2.41	50.79	59.35
Kentucky	49	31.54	38.43	2.34	3.28	53.13	69.12
Louisiana	31	32.79	35.74	--	2.96	49.10	66.74
Mississippi	56	37.31	42.45	--	1.52	49.28	65.05
North Carolina	57	39.91	43.67	1.29	5.52	58.87	77.83
Oklahoma	52	36.97	40.65	--	1.36	49.85	60.20
South Carolina	34	27.38	28.05	3.01	5.65	44.71	57.88
Tennessee	52	34.05	37.25	2.54	4.62	52.27	65.13
Texas	100	36.40	42.40	.84	3.24	54.65	74.61
Virginia	42	29.81	33.66	3.08	5.01	56.19	78.05
South	627	33.53	37.47	1.26	3.22	51.25	66.28
Illinois	51	38.88	44.31	2.82	3.70	56.80	69.55
Indiana	48	21.60	21.60	2.06	2.77	41.33	46.02
Iowa	55	32.76	38.93	1.46	5.99	52.34	66.90
Kansas	42	27.38	34.72	2.64	3.07	47.76	60.83
Michigan	46	25.39	27.09	2.21	2.21	49.30	56.21
Minnesota	42	26.21	28.54	--	9.52	42.04	67.75
Missouri	55	27.57	32.04	--	3.47	37.65	58.20
Nebraska	29	26.32	34.49	--	7.66	42.90	72.02
Ohio	49	28.64	29.66	3.79	5.83	56.48	69.49
South Dakota	19	38.42	39.10	2.00	7.37	66.00	72.05
Wisconsin	43	34.23	42.85	--	5.07	50.05	80.05
North Central	479	29.49	33.70	1.59	4.88	48.62	64.57
South and North Central	1106	31.78	35.84	1.40	3.94	50.11	65.54

10.8 Pre-Test of Enumerative Survey Techniques

Two pre-test studies were made during 1956. The first was made in Michigan where several segments were drawn and visited in March by several members of the Michigan staff along with the Washington staff. The Washington staff was represented by statisticians from the Research and Development Staff, Special Statistics Branch, Dairy Statistics Branch, and Livestock Branch. Teams of two men each interviewed farm operators in several segments. An evaluation period was held before returning to Washington to design the schedule to be used in June. The winter weather conditions were not ideal for testing the schedule, but many questions which had been raised about the suitability of the "closed-segment" approach for livestock were answered.

About August 1, members of the Washington staff went to Ft. Collins, Colorado to conduct a pre-test of suggested working procedures in range and mountainous areas of the country. This group included members of the Research and Development Staff, Special Statistics Branch, and the Livestock Branch. Approximately three days were spent enumerating segments drawn in National Forest areas and on private land, both in the mountains and in the plains regions of the sample county. This pre-test was designed primarily to study problems in delineating segments in that region of the country and to determine the practicability of closed-segment procedures under range and mountain conditions.

10.9 1956 Acreage Verification Survey

The survey on acreage verification in 1956 was planned on a more exacting and elaborate basis than in 1955. 219 Operator Tracts were selected in the South and 148 in the North Central area, from those interviewed in the June Survey. New photos reproduced to the same scale were secured for the segments containing these selected tracts. Steel surveyor's chains were purchased to help the field workers obtain accurate data on the sizes of fields devoted to various uses. The field work was conducted primarily by State Supervisors and the supervisory enumerators. Training for this specific job was provided at the regional training school for the North Central States, Virginia, and Kentucky. Supervisors in the other Southern States received a manual of instructions but no other special training. The survey was conducted on a special field trip during August.

When the sample tract was visited, fields were outlined on the new aerial photograph with extreme care. Any part of a field which was devoted to a different land use than reported in June was outlined on the photograph. For areas less than a chain in width, a sketch of the field was drawn on plain paper and the dimensions, such as width and length of fence rows, drainage ditches, and other unplanted areas, were recorded on the sketch. Fields in woods or non-agricultural uses were outlined on the photographs but no sketches of such areas were prepared. Interviewers were instructed to walk entirely around fields growing crops to identify all unplanted areas and to measure their dimensions.

After the survey was completed, photographs and work sheets were forwarded to Washington where the data were recorded and analyzed.

The cost table below does not include the costs of the additional training at regional schools for this survey. These costs are included in the Objective Measurement cost table for August 1.

Table 10.5--Cost of 1956 Acreage Verification Study

State and Region	Tracts	Total cost		Cost per tract			
				Survey proper		Total	
		Out of pocket	Total	Out of pocket	Total	Out of pocket	Total
	Number	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Alabama	13	276.86	453.24	21.30	31.16	21.30	34.86
Arkansas	18	348.74	379.25	18.64	18.64	19.37	21.07
Georgia	12	283.21	367.81	23.60	30.65	23.60	30.65
Kentucky	21	317.35	346.75	15.11	16.07	15.11	16.51
Louisiana	1	41.59	75.65	41.59	75.65	41.59	75.65
Mississippi	16	203.00	444.00	12.69	23.81	12.69	27.75
North Carolina	32	592.46	938.52	18.51	29.33	18.51	29.33
Oklahoma	26	293.25	470.46	11.28	18.09	11.28	18.09
South Carolina	13	163.70	215.89	12.59	12.59	12.59	16.61
Tennessee	26	391.50	711.18	15.06	27.35	15.06	27.35
Texas	20	163.00	532.00	8.15	26.60	8.15	26.60
Virginia	21	236.67	269.76	11.27	12.85	11.27	12.85
South	219	3,311.33	5,204.51	15.06	22.78	15.12	23.76
Illinois	16	486.92	486.92	30.43	30.43	30.43	30.43
Indiana	12	165.21	165.21	13.77	13.77	13.77	13.77
Iowa	15	426.92	426.92	28.46	28.46	28.46	28.46
Kansas	13	64.00	327.00	4.92	21.23	4.92	25.15
Michigan	15	109.61	385.43	7.31	25.03	7.31	25.70
Minnesota	13	152.12	406.45	11.70	30.06	11.70	31.27
Missouri	13	179.23	566.19	13.79	43.55	13.79	43.55
Nebraska	10	71.00	170.00	7.10	17.00	7.10	17.00
Ohio	18	316.87	395.30	17.31	18.91	17.60	21.96
South Dakota	7	220.00	220.00	31.43	31.43	31.43	31.43
Wisconsin	16	99.97	320.05	6.25	20.00	6.25	20.00
North Central	148	2,291.85	3,869.47	15.45	25.26	15.49	26.15
South and North Central	367	5,603.18	9,073.98	15.22	23.77	15.27	24.72

10.10 October 1 and December 1 Surveys

The October 1 and December 1 surveys were made entirely on an enumerative basis in 1956. In previous years a mailed questionnaire had been sent to farm operators interviewed in the June survey, with a sample non-respondent follow-up. Results from that procedure had been disappointing. As an interview survey can be controlled better, the results should be much more satisfactory. In addition to the crop acreage and production questions which had been asked in previous October 1 surveys, the October 1956 questionnaire contained a section on livestock inventories. For the October survey a sample of 1/8 of the operator tracts for which some crops or livestock had been reported in June was selected for enumeration. For the December survey the sample consisted of 1/4 of the tracts enumerated in June. The selection of these tracts was made in such a manner as to exclude any previously selected for the October survey. Field work on the two surveys was carried out largely during the last full week in September and November, respectively, and travel was combined with travel for the objective yield surveys as much as possible. In the South, 618 tracts were selected for October 1 enumeration and 1,236 for the December survey. In the North Central States 378 tracts were selected for October and 756 for December.

Listing sheets for both surveys were prepared in the Washington office and comparable data from the June schedules for each tract were copied to the listing sheets and forwarded to the States. The State Supervisor then edited and listed the current survey data and prepared estimates from the data.

10.11 Questionnaires

Regional questionnaires were used in both the October 1 and December 1 surveys. Crops for each region were listed in the same manner as on the June schedule. The format for recording data was much the same as in the June schedule, making it easy to train the enumerators. Only one tract was listed on each schedule.

Crop data were recorded on the closed segment basis for the same fields enumerated in the tract in June. However, in these surveys the acreage for a crop was reported for planted acreage, acreage harvested for each utilization, and acreage otherwise used or abandoned. Production reports were required with all reports of harvested acreage.

In October only the closed-segment questions on livestock and poultry were asked and the questions were almost identical with those used in the June survey. A question on chickens in the tract a year ago was also asked to determine the number of tracts which had a major change in poultry operations over a year's time.

In December the crop section was almost identical to that for the October 1 survey. However, more emphasis was placed on late fall-harvested crops which were not yet harvested at the time of the October 1 survey. A section in the December 1 survey also asked for the acreage of small grains in the tract seeded for harvest in 1957. These data were recorded field by field as outlined on the June aerial photographs. The same set of livestock and poultry questions was again asked on the closed-segment basis. Acreage in the entire farm was determined from asking

questions on acres of land owned and rented for farm operators living in the segment. On this land the enumerator determined the total number of cattle and calves, hogs and pigs, sheep and lambs, chickens, and the expected change in these inventories from the time of the December 1 survey to January 1, 1957.

10.12 Interviewers

In most cases the interviewing was done by supervisory enumerators and enumerators used in the June survey. However, when too few of those enumerators were available, a new man was found and trained for the job. Training of interviewers varied from State to State. In some States interviewers came to the State office and received approximately one day of instruction. In other cases the State Supervisor or a supervisory enumerator traveled to the interviewer's home and, through instructions or actual interviewing on the job together, the interviewer was trained to carry out the program assigned to him. Interviewers sent completed schedules to the State office each day. Aerial photographs and other supplies were sent to the office at the end of the interviewing period.

10.13 Editing and Tabulation

As the schedules were received, the State Supervisor edited them independently of the data recorded in June for the same tracts. After the schedules were edited, they were listed with corresponding June data on each tract or field. After listing, the listing sheets were edited. If tract or field data were edited out for one survey they were also edited out for the other survey. The State offices then summarized the livestock and crop items and forwarded the results to Washington.

10.14 Costs

Costs specifically connected with the October 1 or December 1 surveys were difficult to calculate separately. Many of the interviewers were making objective yield observations at the same time and expenses could not be allocated exactly to objective yield survey costs and enumerative survey costs. Costs of these two surveys are included in the cost table for the objective yield surveys.

10.15 Objective Yield Surveys

The objective yield work for 1956 can be divided into three parts: (1) Surveys on winter wheat for May 1, June 1, and July 1, with post-harvest observations; (2) Cotton and corn yield surveys in the Southern States as of August 1, September 1, and October 1, with post-harvest observations later in the fall; (3) Corn and soybean surveys in the North Central States as of August 1, September 1, October 1, and November 1, with post-harvest observations later in the year.

The wheat surveys were conducted only in Texas and Oklahoma in 142 selected fields. A laboratory was established at the Oklahoma office for determining weight and length of heads and moisture, for sample heads clipped from sample plots in the two States. Of the 142 samples selected, 86 were in Oklahoma and 56 in Texas. The following table shows the total cost and the cost per sample in the two States.

Table 10.6--1956 Wheat Survey Field Costs

Item	Samples	Total		Average cost per sample			
		Field expense		Survey proper		Total	
		Out of pocket	Total	Out of pocket	Total	Out of pocket	Total costs
	Number	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Oklahoma	86	1,097	1,627	11.69	16.90	12.76	18.92
Texas	56	926	1,441	12.36	16.64	16.54	25.73
Laboratory	142	140	424	--	--	.98	2.98
Total	142	2,163	3,492	11.95	16.80	15.23	24.59

Table 10.7 lists the number of sample fields assigned to various States for studies on cotton, corn, and soybeans.

Table 10.7--Number of Sample Fields and Teams

A - Southern States

State	Fields			Teams
	Rate of Fruiting Survey - August 1	Regular surveys - all months		
	Cotton	Cotton	Corn	Total	
	Number	Number	Number	Number	Number
Alabama	14	70	70	140	6
Arkansas	25	125	50	175	7
Georgia	14	70	70	140	6
Louisiana	14	70	50	120	5
Mississippi	25	125	50	175	7
North Carolina	14	70	70	140	6
Oklahoma	14	70	50	120	5
South Carolina	14	70	50	120	5
Tennessee	14	70	70	140	6
Texas	52	264	70	334	10
Virginia	--	--	40	40	2
Kentucky	--	--	40	40	2
Total South	200	1,004	680	1,684	70

B - North Central States

State	August 1				Sept. 1, Oct. 1, and Nov. 1			
	Fields			Teams	Fields			Teams
	Soybeans	Corn	Total		Soybeans	Corn	Total	
	Number	Number	Number	Number	Number	Number	Number	Number
Ohio	8	9	17	1	16	47	63	3
Indiana	10	10	20	1	20	53	73	3
Illinois	22	22	44	2	42	112	154	6
Michigan	2	5	7	1	6	23	29	1
Wisconsin	3	7	10	1	5	35	40	2
Minnesota	10	13	23	1	21	66	87	4
Iowa	10	29	39	2	22	136	158	6
Missouri	10	21	31	1	21	75	96	3
South Dakota	3	10	13	1	5	51	56	2
Nebraska	3	14	17	1	6	65	71	3
Kansas	3	4	7	1	6	17	23	1
Total North Central	84	144	228	13	170	680	850	34

Two surveys were conducted on cotton in the South around August 1. The regular survey was made during the last week of July. A subsample of 200 fields was revisited about five days after the first visit to determine the rate of fruiting during a specific period of time. There were 1,004 cotton fields and 600 corn fields in the survey in 12 Southern States, including Virginia and Kentucky for the first time this year. But Virginia and Kentucky did not have any cotton samples. In the North Central States a total of 170 soybean fields and 680 corn fields were selected, making a total of 850 fields to be visited in the 11 North Central States. The Southern surveys were conducted as of August 1, September 1, and October 1. Each field was visited in each of these three months, or until the field was harvested. In the North Central States a different schedule was used. For the August 1 survey only a subsample of 84 soybean and 144 corn fields was visited. All fields were visited as of September 1, October 1 and November 1, or until the crop was harvested.

The laboratory work required for the field samples in the Southern States was handled individually by each State. In some cases laboratory equipment was available through cooperating State agencies or by other agencies of the Department of Agriculture. For the North Central States, a soybean laboratory was set up in the Illinois State office. Corn samples were sent to the Statistical Laboratory at Iowa State College for analysis.

10.16 Interviewers and Supervision

The enumerators in most cases were supervisory enumerators and the better enumerators used in the June survey who were available during the rest of the year. In most cases the "teams" consisted of only one man, although in some areas two men worked as a team, in training or in doing the actual field work.

The training program for the objective yield surveys varied between the North Central States and the South. No regional training schools were held in 1956 for State Supervisors in the Southern States. Since this was the first year in the program for the North Central States, Virginia and Kentucky, all State Supervisors and some supervisory enumerators went to Lafayette, Indiana, for a regional training school, which was conducted by members of the Washington staff.

Enumerators in individual States were trained under the direction of the State Supervisor. No official training guide was provided. In most cases enumerators were trained for at least one day at the State office. In some cases a short field trip was made to nearby areas where actual experience was gained. In other States, where the number of teams was relatively few, the State Supervisor visited each enumerator and worked with him for a day or until he understood the program he was to follow. In most of the North Central States the August 1 survey was conducted by the State Supervisor or the supervisory enumerator; therefore, training of other field workers was not conducted until just prior to the September 1 survey.

Field supervision was limited after the enumerator began work, and most supervision had to be handled betweeen survey periods to insure that enumerators did not repeat the same mistakes. Since the October 1 and December 1 interview surveys were made partly in conjunction with objective yield field work, this allowed for supervisory contacts with enumerators who were also handling interviews for the enumerative surveys.

The State Supervisor received the schedules and determined whether any editing corrections were required. The schedules were listed, summarized, and forwarded to Washington under a specific time schedule.

10.17 Questionnaires

The questionnaires for cotton, corn, and wheat were modified versions of those used in preceding years. As this was the first year for soybean yield studies, a new set of soybean questionnaires was prepared with the advice of crop specialists.

10.18 Survey Costs

Some notes on survey costs seem appropriate. The difference between the Survey Proper and Total Costs for the August 1 survey in the Southern States can be explained by enumerator training in all States, except Virginia and Kentucky where the difference is primarily due to the attendence of the State Supervisor and supervisory enumerator at the regional school in Lafayette, Indiana. In the North Central States the total August 1 survey costs were lower because all of the sample fields were not visited that month. The difference between the Survey Proper and Total Costs in this area is primarily due to cost of training the State Supervisor and supervisory enumerator at the regional school. In the September 1 survey in the South, the Survey Proper accounts for almost all the cost of the survey. However, in the North Central States the difference between the Survey Proper and Total Costs is practically all accounted for by training additional enumerators. Very little cost in either case was attributed to hiring new enumerators or editing schedules.

The October 1 Survey Costs include both the objective yield survey and the October enumerative survey. This accounts for the increased number of schedules shown. The cost of the Survey Proper in both regions accounted for most of the expense of the survey. In some States the cost of enumerator training or the additional cost of having the supervisory enumerators help with the editing caused some difference between Survey Proper and Total Costs.

Costs of the November 1 survey apply only to the North Central region where a formal survey was conducted. During November, and the latter part of October, enumerators were conducting post-harvest observations in the South, but their expenses have been included with the December 1 Survey Costs. Some difference in Survey Proper and Total Costs is noted in the North Central region. Indiana and Michigan each retained one enumerator. In other States this difference represents editing expense by the supervisory enumerator.

December 1 cost include Objective Yield and December Enumerative Survey Costs. The number of schedules taken in these two surveys is shown. In most cases the entire cost of the post-harvest observations was included. Additional training of enumerators was conducted in Georgia, North Carolina, Indiana, and Michigan. Other States showed no expense for additional training of enumerators. Kentucky, Minnesota, and Ohio reported an additional expense for hiring new enumerators and their training costs are included. The average cost for editing the December 1 enumerative schedule was $0.62 in the South and $0.65 in the

North Central region. This remains fairly consistent by States. However, the cost of the Survey Proper, which includes travel and salaries of enumerators in the field, makes up most of the total expenses.

Table 10.8--August 1, 1956 Objective Yield Costs

State and Region	Sample	Total cost		Cost per sample			
				Survey proper		All	
		Out of pocket	Total	Out of pocket	Total	Out of pocket	Total
	Number	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Alabama	140	1,126.68	1,317.87	6.82	6.82	8.05	9.41
Arkansas	175	1,279.34	1,873.98	6.07	6.95	7.31	10.71
Georgia	140	1,152.55	1,687.07	6.26	7.80	8.23	12.05
Kentucky	40	637.31	837.96	12.95	15.67	15.93	20.95
Louisiana	120	1,022.53	1,384.81	7.64	8.79	8.52	11.54
Mississippi	175	1,596.00	2,138.00	7.95	9.98	9.12	12.22
North Carolina	140	1,777.57	2,215.49	10.69	12.42	12.70	15.82
Oklahoma	120	940.66	1,374.42	6.52	9.54	7.84	11.45
South Carolina	120	933.35	1,207.16	6.46	7.60	7.78	10.06
Tennessee	140	1,088.87	1,509.29	5.83	7.41	7.78	10.78
Texas	334	3,819.00	5,095.00	8.68	10.63	11.43	15.25
Virginia	40	789.73	1,030.61	10.73	13.25	19.74	25.77
South	1,684	16,163.59	21,671.66	7.67	9.27	9.60	12.07
Illinois	44	1,278.32	1,797.18	15.32	20.55	29.05	40.84
Indiana	20	267.48	371.16	9.42	9.42	13.37	18.56
Iowa	39	664.96	990.13	8.74	11.95	17.05	25.39
Kansas	7	196.00	452.00	.86	19.43	28.00	64.57
Michigan	7	98.29	325.29	6.12	22.83	14.04	46.47
Minnesota	23	368.62	717.48	10.46	22.23	16.03	31.19
Missouri	31	331.85	844.32	7.18	17.92	10.70	27.24
Nebraska	17	213.29	452.29	4.23	8.64	12.55	26.61
Ohio	17	357.15	540.56	9.74	14.98	21.01	31.80
South Dakota	13	767.00	847.00	4.51	51.31	59.00	65.15
Wisconsin	10	347.97	762.67	23.26	44.34	34.80	76.27
North Central	228	4,890.93	8,100.08	12.16	19.24	21.45	35.53
South and North Central	1,912	21,054.52	29,771.74	8.21	10.46	11.01	15.57

Table 10.9--September 1956 Objective Yield Costs

State and Region	Samples	Total cost		Cost per sample			
				Survey proper		All	
		Out of pocket	Total	Out of pocket	Total	Out of pocket	Total
	Number	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Alabama	140	738.25	791.70	4.67	4.67	5.27	5.66
Arkansas	175	1,144.22	1,734.94	5.14	7.06	6.54	9.91
Georgia	140	733.46	935.91	5.24	6.14	5.24	6.69
Kentucky	40	398.57	457.20	9.96	11.12	9.96	11.43
Louisiana	120	608.74	861.07	5.07	6.88	5.07	7.18
Mississippi	175	1,037.00	1,409.00	5.93	7.69	5.93	8.05
North Carolina	140	812.49	1,323.84	5.71	7.90	5.80	9.46
Oklahoma	120	615.17	875.80	5.13	7.30	5.13	7.30
South Carolina	120	626.99	738.38	5.13	5.42	5.22	6.15
Tennessee	140	492.81	683.01	3.52	4.76	3.52	4.88
Texas	334	1,541.00	2,316.00	4.41	6.43	4.67	7.02
Virginia	40	255.84	346.19	6.40	8.03	6.40	8.65
South	1,684	9,004.54	12,473.04	5.10	6.61	5.36	7.42
Illinois	154	1,512.21	1,840.72	9.54	11.22	9.82	11.95
Indiana	73	904.51	904.51	6.82	6.82	12.39	12.39
Iowa	158	2,268.10	2,902.30	10.41	13.52	14.36	18.37
Kansas	23	39.00	276.00	1.70	10.65	1.70	12.00
Michigan	29	351.92	637.86	12.14	18.03	12.14	22.00
Minnesota	87	1,067.50	1,458.29	7.50	8.57	12.27	16.76
Missouri	96	873.71	1,473.19	9.10	14.39	9.10	15.35
Nebraska	71	782.00	1,045.00	8.32	8.77	11.01	14.72
Ohio	63	749.55	884.39	8.87	9.24	11.90	14.04
South Dakota	56	534.00	534.00	8.77	8.77	9.54	9.54
Wisconsin	40	534.98	776.75	12.58	15.59	13.37	19.42
North Central	850	9,617.48	12,773.01	9.02	11.27	11.31	14.98
South and North Central	2,534	18,622.02	25,206.05	6.42	8.18	7.36	9.96

Table 10.10--October 1956 Costs (Objective Yield and Enumerative Survey)

State and Region	Schedules	Total cost		Cost per schedule			
				Survey proper		All	
		Out of pocket	Total	Out of pocket	Total	Out of pocket	Total
	Number	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Alabama	161	846.38	991.45	5.26	5.26	5.26	6.16
Arkansas	172	971.38	1,584.82	5.65	7.18	5.65	9.21
Georgia	121	677.60	934.10	5.28	6.13	5.60	7.72
Kentucky	94	778.84	997.85	8.06	8.96	8.29	10.62
Louisiana	81	806.65	1,033.65	9.96	12.76	9.96	12.76
Mississippi	218	1,337.00	1,807.00	5.31	6.92	6.13	8.29
North Carolina	205	1,678.42	2,662.99	8.19	11.07	8.19	12.99
Oklahoma	100	1,332.92	1,746.70	13.33	17.47	13.33	17.47
South Carolina	142	701.32	1,014.09	4.42	4.87	4.94	7.14
Tennessee	189	791.43	1,408.94	4.19	7.40	4.19	7.45
Texas	264	2,019.00	2,783.00	7.24	9.66	7.65	10.54
Virginia	63	467.97	702.32	7.43	10.97	7.43	11.15
South	1,810	12,408.91	17,666.91	6.62	8.60	6.86	9.76
Illinois	162	1,377.48	1,576.60	8.50	9.32	8.50	9.73
Indiana	91	773.81	773.81	6.57	6.57	8.50	8.50
Iowa	151	1,930.65	2,206.10	11.81	12.68	12.79	14.61
Kansas	38	169.00	596.00	4.45	15.02	4.45	15.68
Michigan	57	473.85	843.69	8.31	12.00	8.31	14.80
Minnesota	115	870.91	1,238.08	7.16	8.72	7.57	10.77
Missouri	103	1,175.36	1,597.86	11.41	15.19	11.41	15.51
Nebraska	79	631.02	774.28	7.89	8.81	7.99	9.80
Ohio	99	783.29	1,107.55	6.23	7.46	7.91	11.19
South Dakota	71	565.00	578.00	7.51	7.51	7.96	8.14
Wisconsin	75	938.91	1,378.39	12.52	16.21	12.52	18.38
North Central	1,041	9,689.28	12,670.36	8.75	10.59	9.31	12.17
South and North Central	2,851	22,098.19	30,337.27	7.40	9.33	7.75	10.64

Table 10.11--November 1956 Objective Yield Costs

State and Region	Samples	Total cost		Cost per sample			
				Survey proper		All	
		Out of pocket	Total	Out of pocket	Total	Out of pocket	Total
	Number	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Illinois	154	1,349.21	1,458.21	8.76	9.47	8.76	9.47
Indiana	73	484.17	484.17	5.23	5.23	6.63	6.63
Iowa	158	1,179.45	1,516.89	7.29	8.87	7.46	9.60
Kansas	23	8.00	54.00	.35	2.04	.35	2.35
Michigan	29	268.36	420.67	8.82	10.63	9.25	14.51
Minnesota	87	677.80	792.85	7.79	8.18	7.79	9.11
Missouri	96	163.48	295.94	1.70	3.03	1.70	3.08
Nebraska	71	475.84	526.04	6.56	6.56	6.70	7.41
Ohio	63	499.89	655.45	7.55	9.60	7.93	10.40
South Dakota	56	498.00	498.00	8.50	8.50	8.89	8.89
Wisconsin	40	367.13	606.73	9.18	14.12	9.18	15.17
Total	850	5,971.33	7,308.95	6.79	7.90	7.03	8.60

Table 10.12--December 1956 Objective Yield and Enumerative Survey Costs

State and Region	Schedules	Total cost		Cost per schedule			
				Survey proper		All	
		Out of pocket	Total	Out of pocket	Total	Out of pocket	Total
	Number	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Alabama	228	1,503.51	1,790.32	6.59	7.05	6.59	7.85
Arkansas	232	1,678.74	2,253.08	7.24	8.33	7.24	9.71
Georgia	225	1,258.05	1,607.09	5.40	5.99	5.59	7.14
Kentucky	139	1.285.17	1,579.46	8.82	10.05	9.25	11.36
Louisiana	177	610.74	861.66	3.45	4.87	3.45	4.87
Mississippi	272	968.53	1,103.53	3.56	3.89	3.56	4.06
North Carolina	282	2,099.82	3,226.55	6.97	9.43	7.45	11.44
Oklahoma	177	1,523.02	1,771.53	8.60	10.01	8.60	10.01
South Carolina	175	904.89	1,061.92	5.17	5.21	5.17	6.07
Tennessee	254	1,218.17	1,631.55	4.80	6.28	4.80	6.42
Texas	433	2,220.00	3,102.00	4.79	6.54	5.13	7.16
Virginia	96	721.64	930.93	7.52	9.30	7.52	9.70
South	2,690	15,992.28	20,919.62	5.80	7.01	5.95	7.78
Illinois	226	1,196.58	1,513.26	5.29	6.36	5.29	6.70
Indiana	115	734.78	734.78	4.99	4.99	6.39	6.39
Iowa	195	2,190.40	2,665.50	11.04	12.64	11.23	13.67
Kansas	75	154.00	562.00	2.05	6.86	2.05	7.49
Michigan	84	556.63	911.13	6.38	7.83	6.63	10.85
Minnesota	149	787.14	1,047.45	4.53	5.07	5.28	7.03
Missouri	183	1,251.99	1,872.07	6.84	10.23	6.84	10.23
Nebraska	106	518.86	649.58	4.88	5.70	4.89	6.13
Ohio	139	784.82	1,034.27	5.58	6.21	5.65	7.44
South Dakota	78	517.00	517.00	6.13	6.13	6.63	6.63
Wisconsin	104	1,161.39	1,665.79	11.17	15.11	11.17	16.02
North Central	1,454	9,853.59	13,172.83	6.52	8.11	6.78	9.06
South and North Central	4,144	25,845.87	34,092.45	6.05	7.40	6.24	8.23

10.19 Research Fund Obligations for Calendar Year 1956

Funds for the research program are allocated on a fiscal year basis but the work is planned on a calendar year basis. Therefore, it may be of interest to see how the obligations for the calendar year 1956 were broken down among expenditures in the field and Washington. During 1956 a total of $361,926.63 was obligated. Of this total, 43 percent went to regular salaries of full-time personnel in the Agricultural Estimates Division. In Washington, salaries of the Research and Development Staff and several other people were paid from this fund. In the Field, each State in the program was allocated a sum for salaries of regular personnel. Salaries of enumerators and supervisory enumerators are shown as a separate item and total 20 percent of the budget.

Travel has been broken down into two items--that spent by Washington personnel and that spent entirely through the State offices. Field travel includes that of the State Supervisor, supervisory enumerators, and enumerators, both in the surveys themselves and in the hiring and training of temporary employees.

Under Other Contracts, expenditures were primarily for wheat frames, photo boards, maps and aerial photographs. The College Contract item is the amount which the research program contributed to the studies at North Carolina State College and Iowa State College, over and above direct salary payments to people stationed at the Colleges.

Supplies, Material and Equipment includes office equipment as well as steel tapes, threshers, scales and other materials bought for the studies on objective yield and acreage verification.

Table 10.13--Research Fund Expenditures January 1-December 31, 1956

	Dollars	Percent
SALARIES		
Washington Staff	$ 48,871.90	13.5
Field Regular Staff	105,779.85	29.2
Field Non-regrular Staff	74,087.18	20.5
Total	228,738.93	63.2
TRAVEL		
Washington Travel	$ 12,582.97	3.5
Field Travel	76,745.85	21.2
Total	89,328.82	24.6
COMMUNICATIONS		
Washington Total	$ 528.56	.2
Field Total	837.59	.2
Total	1,366.15	.4
PRINTING AND REPRODUCING		
Multilith and Mimeograph	$ 1,185.68	.3
Photographic	51.15	.01
Total	1,236.83	.3
OTHER CONTRACTS		
Graphics	$ 111.02	.03
Group Insurance (DC)	166.33	.05
Group Insurance (Field)	513.26	.1
Shop Requests	4,382.01	1.2
College Contract	23,830.00	6.6
Field Contracts	602.22	.2
Total	29,604.84	8.2
SUPPLIES, MATERIALS, EQUIPMENT		
Washington Obligations	$ 5,116.86	1.4
Field Obligations	4,802.87	1.3
Total	9,919.73	2.7
F I C A		
Washington	$ 52.65	.01
Field Regular Personnel	106.61	.03
Field Non-regular	1,447.58	.4
Total	1,606.84	.4
TRANSPORTATION OF THINGS	124.49	.04
TOTAL 1956 OBLIGATIONS	$361,926.63	